Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

10 EMPIRE BUILDING NOVEMBER, 1945 PITTSBURGH, PA.

HNOLOGY DEPT.

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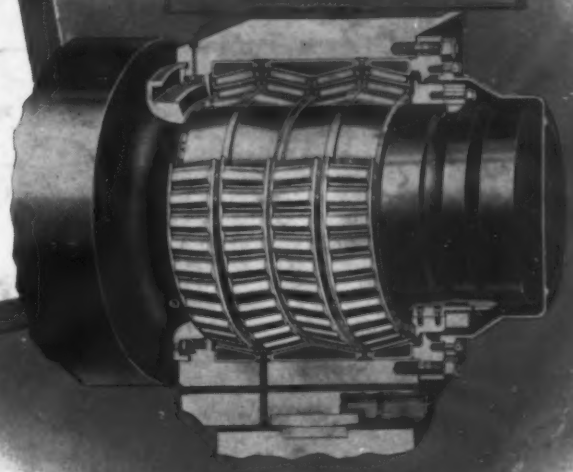
DETROIT

NO OTHER BEARING OFFERS All THESE ADVANTAGES FOR ROLL NECKS



Before selecting roll neck bearings for new or existing mills, it will pay you to compare the Timken "Balanced Proportion" Roller Bearing with any other bearings you may have in mind, on the basis of the following advantages:

Superior operating smoothness of the Timken Roller Bearing.

4 Maximum thrust capacity without the use of external supports such as thrust rings or plates.

7 Consistently lower maintenance cost; the Timken Roll Neck Bearing is entirely self-contained; does not depend on a complicated system of pipes and pumps.

High mill separating force capacity in relation to diameter of roll neck.

5 Simplicity and economy of lubrication.

8 Make possible instant restarting of all types of mills at any time without release of roll pressure and consequent loss of production.

Low roll neck stress and deflection in relation to roll separating force capacity.

6 Greater ease of handling on and off the roll necks; no delicate or complicated parts to handle.

9 Proved ability to roll greater tonnages than ever have been rolled by any other roll neck bearings and at the lowest bearing cost per ton ever recorded.

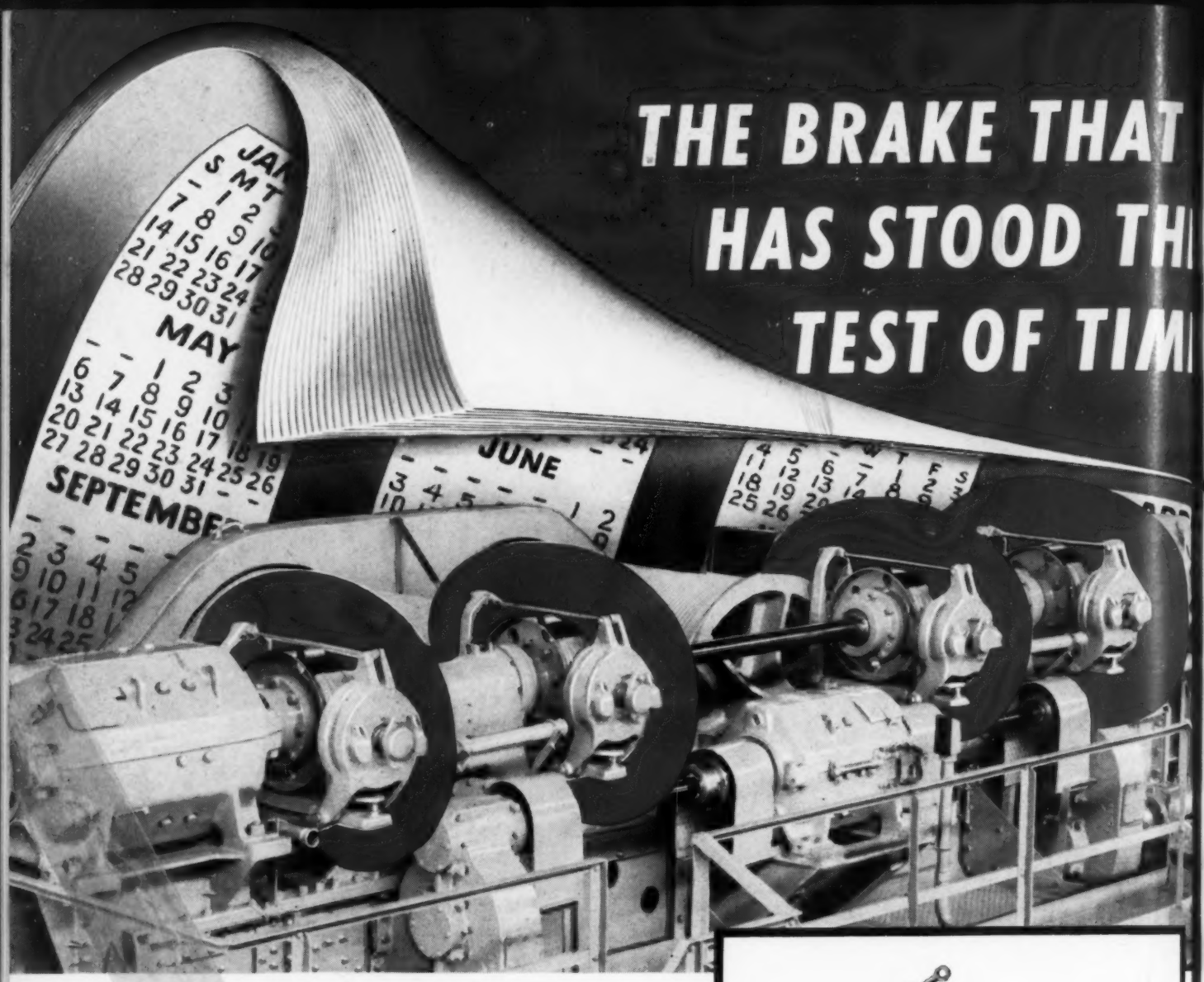
The Timken "Balanced Proportion" Roll Neck Roller Bearing is the culmination of 25 years of constant engineering development and experience.

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

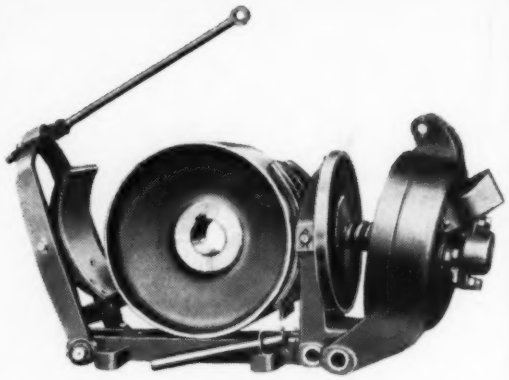
TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

ROLL NECK BEARINGS



Cutler-Hammer engineers, long versed in mill requirements, designed the C-H Type M Brake with those specific needs in mind. With braking essentials concentrated into a few rugged parts, the C-H Type M Brake is simplicity itself; yet endowed with all the durability demanded by heavy duty operations. So dependable and efficient has been its performance that the C-H Type M Brake has never relinquished its preferred position anywhere. This matchless record is but another tribute to the engineering skill that has made the name Cutler-Hammer world-famous . . . another reason why discriminating users of electrical equipment today insist on Cutler-Hammer Brakes for each and every heavy duty installation. CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto, Ont.



Power transmitted in a straight line is power at its greatest efficiency

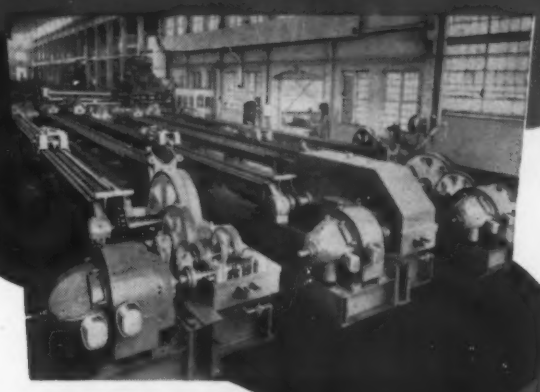
Exploded view of C-H Type M Magnetic Brake shows simplicity of design, ruggedness of parts and directness of power application.

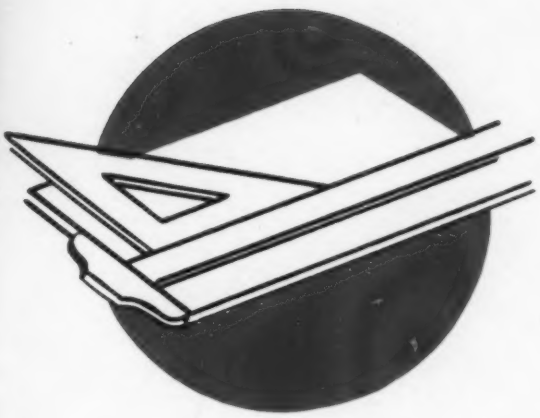
CUTLER·HAMMER
MOTOR CONTROL
C-H

Designers and Builders to the

STEEL

NON-FERROUS





AND OTHER INDUSTRIES

PLASTIC
RUBBER
CHEMICAL
FOOD
RAILROAD
OIL
MANY OTHERS

The

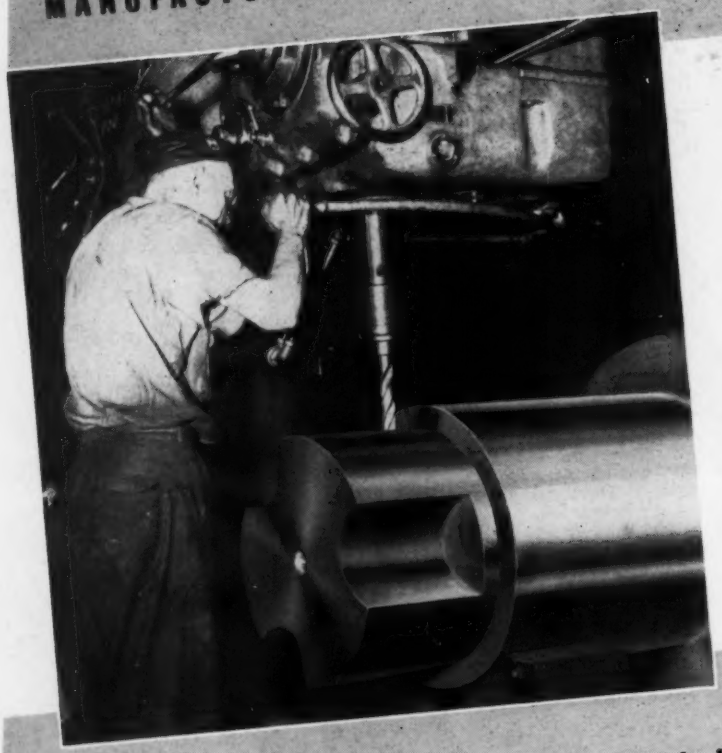
AETNA-STANDARD ENGINEERING CO.

YOUNGSTOWN, OHIO

ARMY E NAVY

ASSOCIATED COMPANIES:
HEAD, WRIGHTSON & COMPANY, LIMITED
THORNABY-ON-TEES, ENGLAND
JOHN INGLIS COMPANY, LIMITED
TORONTO, ONTARIO, CANADA

MANUFACTURING EXPERIENCE AND EQUIPMENT MAKES THEM RIGHT!



NATIONAL ROLLS

EXACTING METALLURGICAL CONTROL KEEPS PERFORMANCE PROMISES!

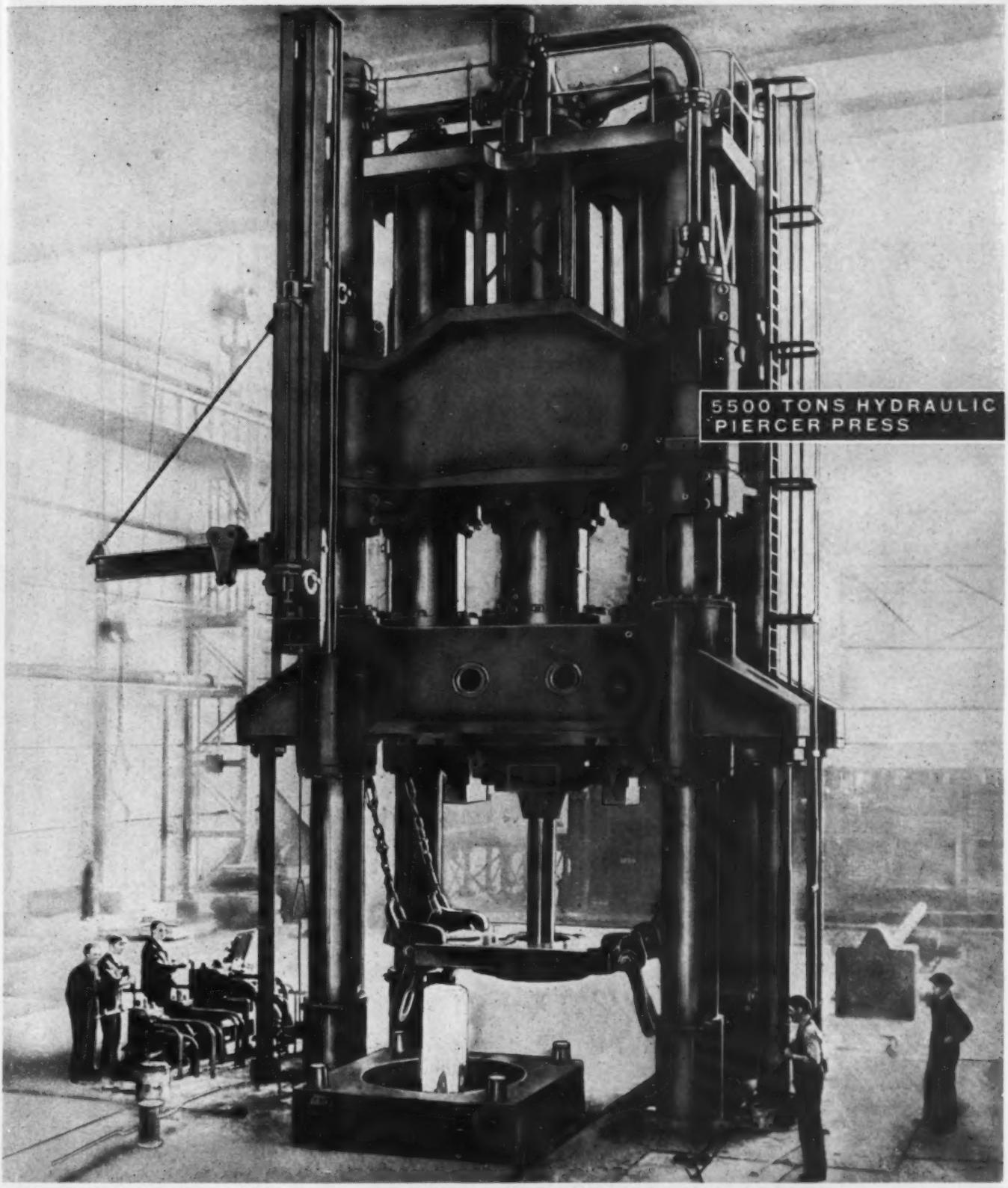
Into the manufacture of every National roll goes the knowledge accumulated through years of experience. Completely modern equipment in foundries and shop facilitates precision production. Strict metallurgical control, under laboratory supervision, assures long wearing rolls having sound physical properties. At National these factors combine to produce rolls that fully meet specifications and frequently exceed service expectations.

THE NATIONAL ROLL & FOUNDRY CO.

AVONMORE, PENNSYLVANIA

Manufacturers of: ALL GRADES OF CAST ROLLS • IRON & ALLOY IRON STEEL & ALLOY STEEL • HEAVY IRON & STEEL CASTINGS • ROLLING MILL EQUIPMENT

ARMY E NAVY



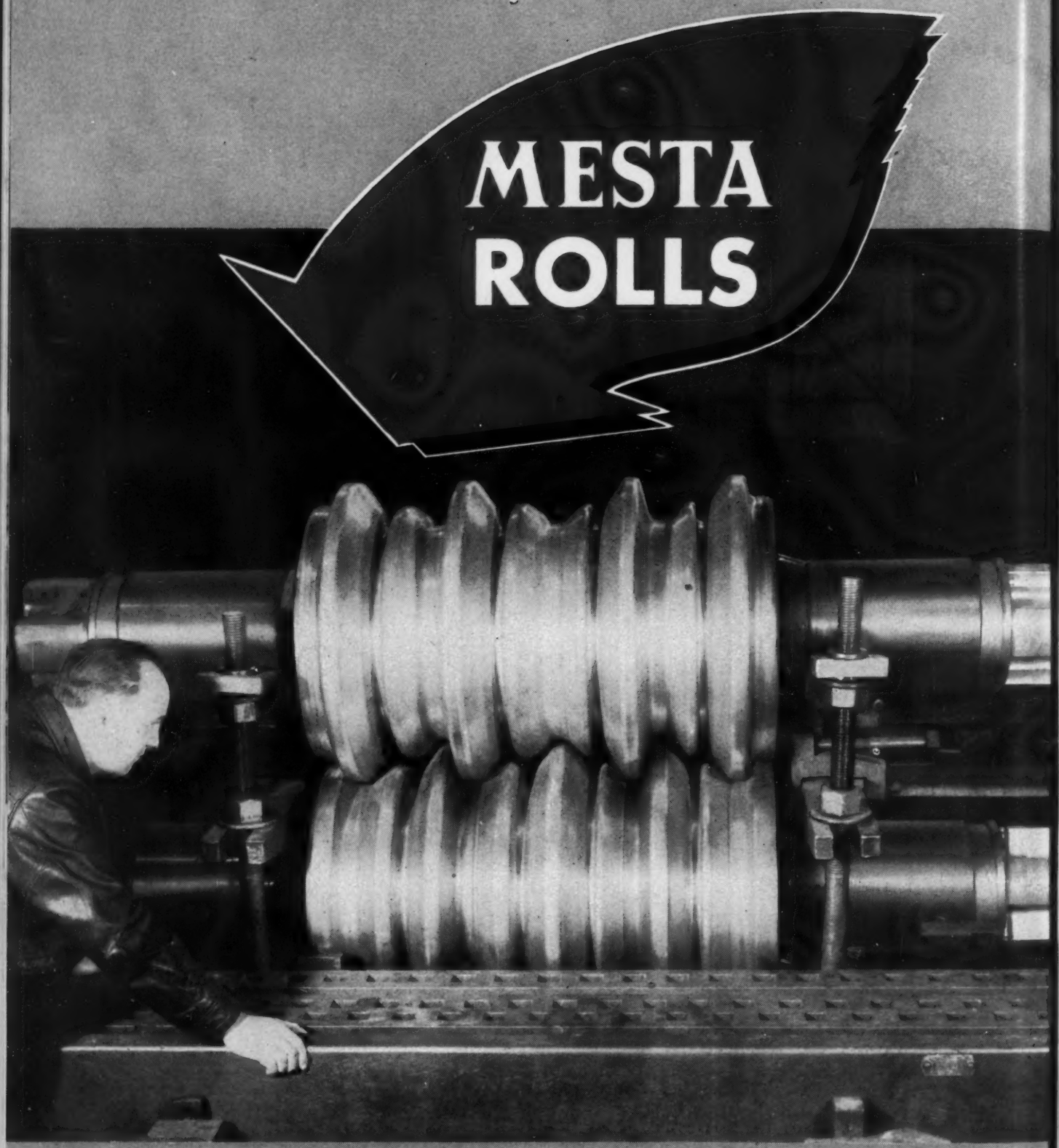
HYDROPRESS · INC.

ENGINEERS CONTRACTORS

HYDRAULIC PRESSES · ROLLING MILLS
STRETCHERS · PUMPS · ACCUMULATORS

570 LEXINGTON AVENUE · NEW YORK · N Y

MESTA ROLLS



ARMY E NAVY

Mesta Merchant Mill Rolls
For Rolling I-Beams

MESTA MACHINE COMPANY · PITTSBURGH, PA.

EC&M Control has Outstanding Advantages for DIESEL-ELECTRIC Cranes

Portal Crane by Washington Iron Works, Seattle, Wash. equipped with EC&M Control and Type WB Brakes.

Washington Iron Works takes advantage of the inherent safety and quick response in operation of series-wound brakes and the simplicity and better characteristics of series motors for the hoists of their Portal Cranes.

The EC&M Wright Dynamic Lowering Circuit Controller prevents heavy peak loads on the Diesel-Generator, because—

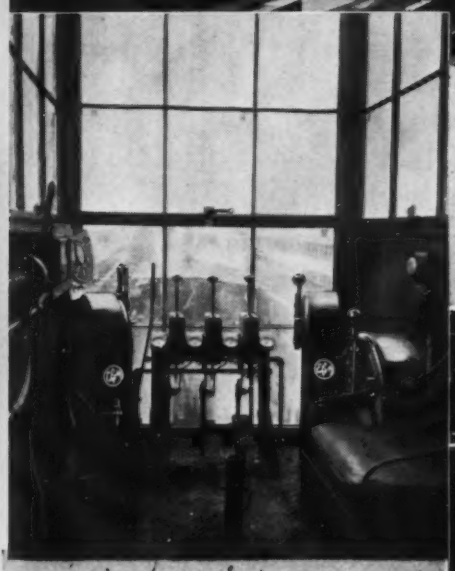
1 All line current passes through the brake coil on the first point lowering to insure quick brake release with minimum power.

2 TIME-CURRENT Relays retard the rate of acceleration of heavy loads in hoisting, yet allow faster operation with light loads.

Specify EC&M Control for your cranes to get these exclusive advantages.

THE ELECTRIC CONTROLLER AND MANUFACTURING CO.

2698 EAST 79TH STREET CLEVELAND 4, OHIO



Operator's Cab (Seat Removed) shows efficient arrangement of Master Switches and Clutch Pilot-levers.

Hoist unit—Magnetic Control Panels and Type H Alloy Grid Resistors (overhead).

DEPENDABILITY

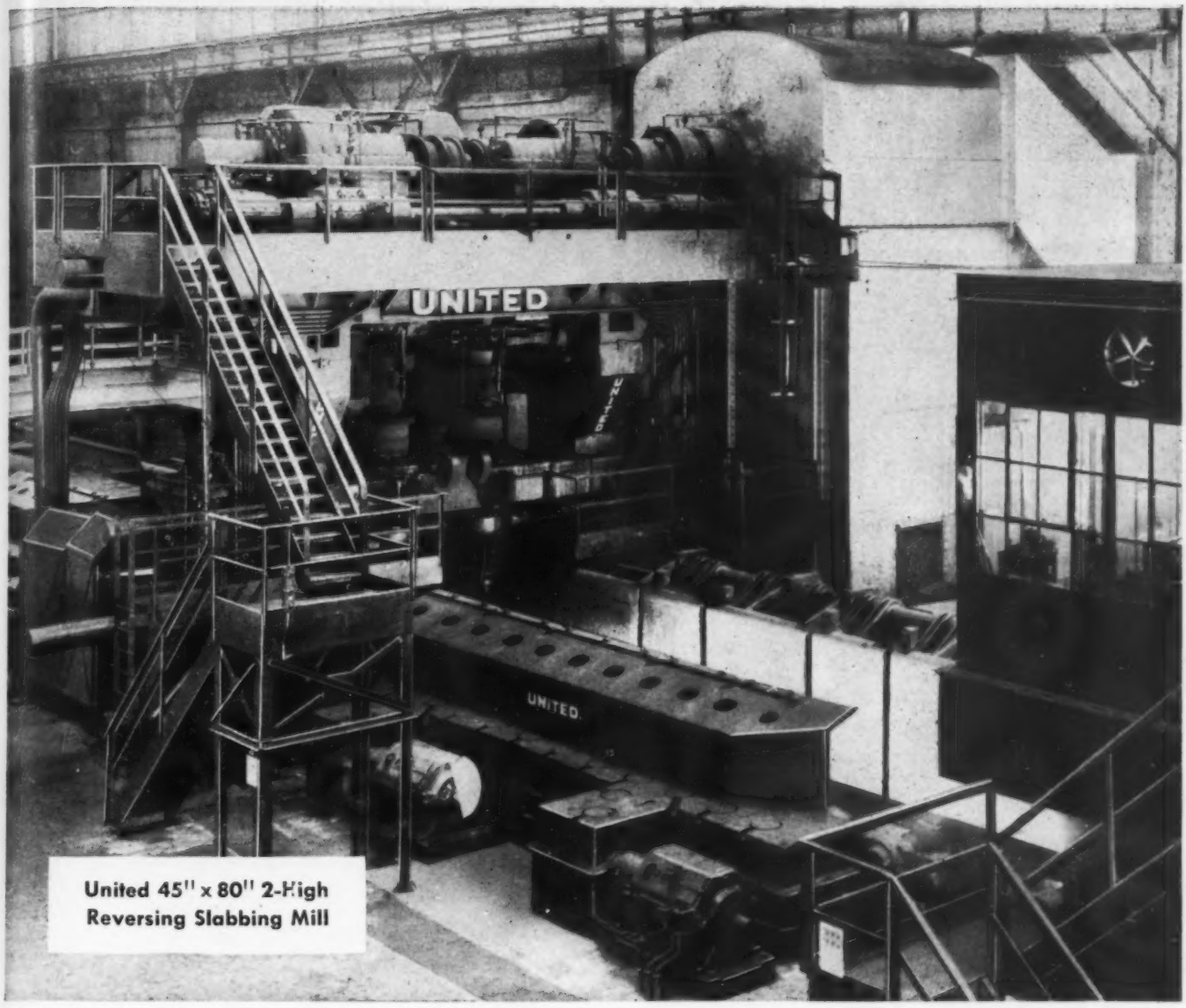
and superiority of "TRANTINYL" ALLOY STEELS *are facts recognized in the rolling mill industry. Long life and freedom from "pick-up" are characteristics of* "TRANTINYL" *which result in*

REDUCED COST
INCREASED YIELD
IMPROVED QUALITY

Don't lift your eyebrows when we tell you that the new "Trantinyl" guides will last TEN TIMES as long as the ones you are now using. Make us prove it! In all instances where "Trantinyl" has been used, tonnage went up and scrap came down; moreover, every user has broken his own guide tonnage record. We will give you case histories that will warrant your trying these revolutionary guides. BUT BETTER THAN THAT, we will furnish you with trial guides, gratis, in order to substantiate these unusual claims.

SEAMLESS TUBE MILL: Guide Shoes - Plugs - WELDED TUBE MILL: Rolls - Plugs
Miscellaneous Castings - BAR, SHAPE AND STRIP MILL: Guides - Rollers

YOUNGSTOWN ALLOY CASTING CORPORATION
Youngstown, Ohio, U.S.A.



United 45" x 80" 2-High Reversing Slabbing Mill

UNITED

2-High Reversing Slabbing Mill

Because production requirements vary for practically every installation, complete standardization of slabbing mill design is impractical. Each new mill is largely custom-built for the job it is intended to do in the general process of rolling steel product. This opens the way for the development and incorporation of new features, and gives the mill designer opportunity for improvement in each new unit brought out. A recent example is the mill here illustrated.

During a lifetime of service to the rolling industry, UNITED'S engineers have contributed numerous "firsts"—many of which today are standard practice—to mill design.

Why not consult them on your next rolling application?

UNITED ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

Plants at PITTSBURGH · VANDERGRIFT · NEW CASTLE · YOUNGSTOWN · CANTON
Subsidiary: Adamson United Company, Akron, Ohio
Affiliates: Davy and United Engineering Company, Ltd., Sheffield, England
Dominion Engineering Works, Ltd., Montreal, P. Q., Canada

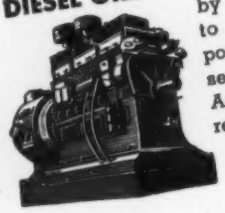
★The World's Largest Designers and Makers of Rolls and Rolling Mill Equipment

TURN TO TYCOL "Engineered

ENGINEERED SOLUTIONS TO YOUR LUBRICATION PROBLEMS *at your fingertips*

Tycol lubricants are made in a comprehensive line to meet each specific service requirement. Their performance-proved lubricating ability is the result of modern scientific engineering and rigid testing. The line includes:

DIESEL OILS of 100% paraffine base, refined by the most modern processes to eliminate unstable compounds that would oxidize in service. There is a Tide Water Associated Oil for every Diesel requirement.



SPECIALIZED INDUSTRIAL LUBRICANTS for all types of machinery in all types of industry — from steel to textile.

GREEN CAST GREASES, made from paraffine base cylinder oil with a minimum of soap . . . extremely economical, giving greater lubrication per pound than do conventional greases.

TURBINE OILS with great stability and resistance to emulsification . . . free from sludge-forming hydrocarbons . . . engineered to inhibit Rust.

VEEDOL MOTOR OIL, refined from 100% Pennsylvania Crude by Tide Water Associated's triple-refining process, which produces that tough "film of protection" — famous all over the world.

CYLINDER OILS refined from 100% Pennsylvania Crude. They have exceptionally high resistance to breakdown under high temperature operation.

Any Tide Water Associate office will help you select the oil or grease best suited to your needs.

Drums! Drums! Drums!

War needs make it imperative that all empty drums be returned immediately.

TYCOL

TYCOL INDUSTRIAL

ENGINEERED FOR EVERY

Lubrication"

FOR GREATER SERVICE...LONGER LIFE

from *everything* that *TURNS!*

All equipment will last longer – give better service – if the proper lubricant is used. That's why you will find it profitable to use Tycol oils and greases.

There's a reason! No matter what your lubricating need – extreme pressure*, high or low temperature, high speed, or any other service condition – there's a Tycol Oil or Grease scientifically engineered exactly to suit your specific requirements.

Refined from the highest grade crudes, Tycol lubricants are exceptionally resistant to breakdown which means greater economy . . . longer machine life for every type of equipment.

Tide Water Associated engineers will gladly recommend the Tycol lubricant that meets your particular requirements. Call, write or wire your nearest Tide Water Associated office today.

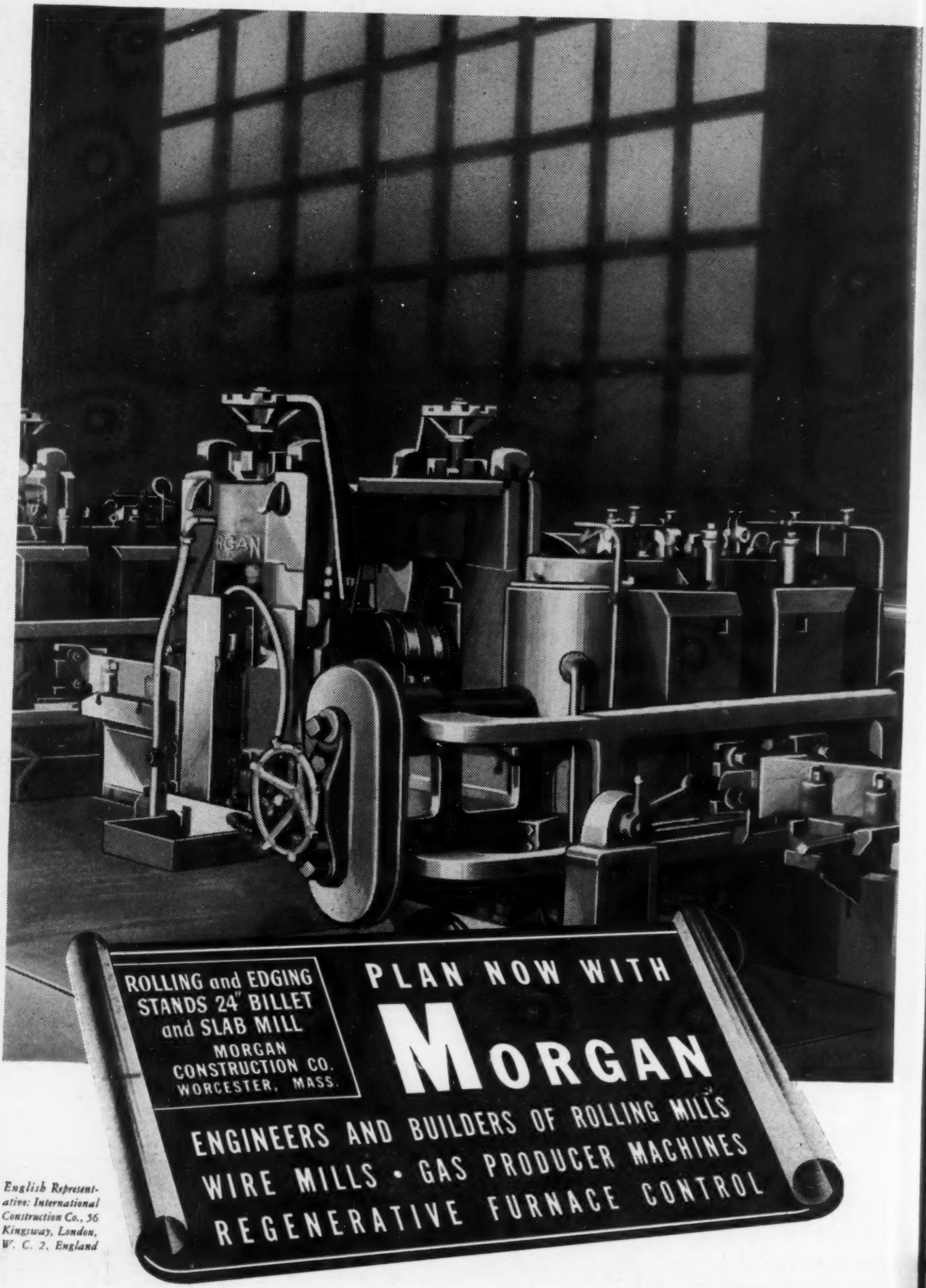
Makers of the Famous VEEDOL Motor Oil

***EXTREME PRESSURE!** For clear, concise descriptions of the basic tests used to determine important lubricant properties – Viscosity, Pour Point, Extreme Pressure and many others – consult Tide Water Associated's informative handbook "Lubricania". For your FREE copy write: Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

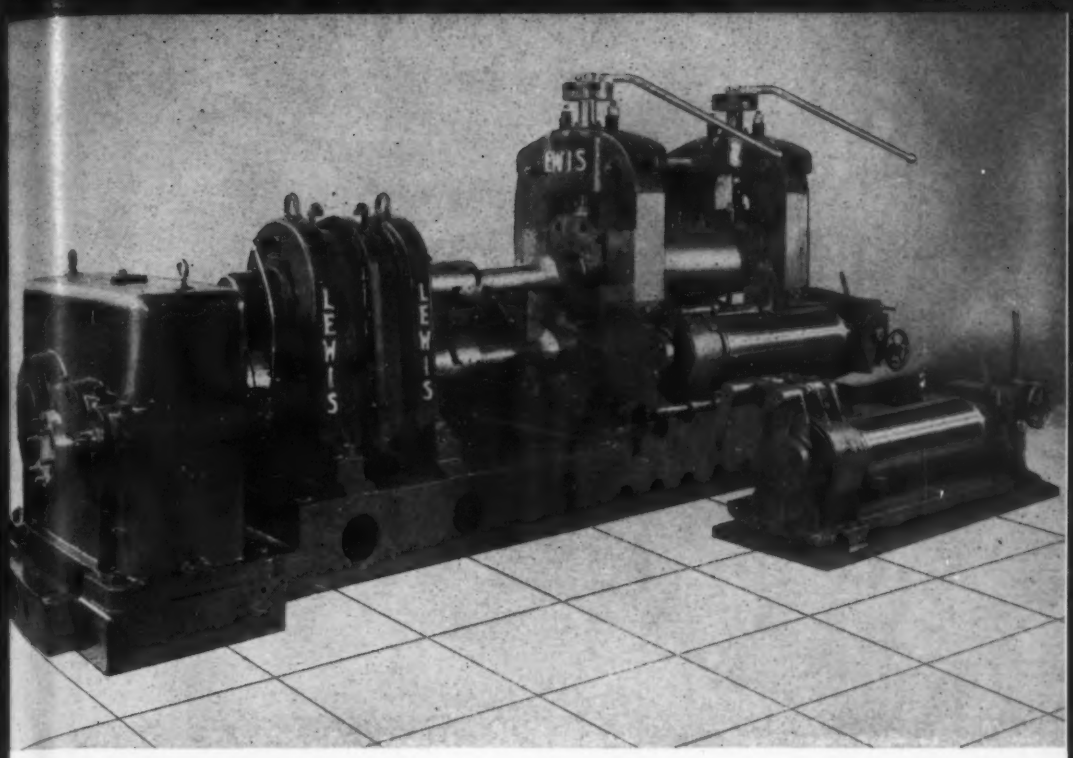
LUBRICANTS
SERVICE NEED

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE · NEW YORK 4, N. Y.

PRINCIPAL OFFICES
BOSTON · PHILADELPHIA
PITTSBURGH · CHARLOTTE, N.C.



English Representative: International Construction Co., 56 Kingsway, London, W. C. 2, England



PRECISION
PRECISION
PRECISION

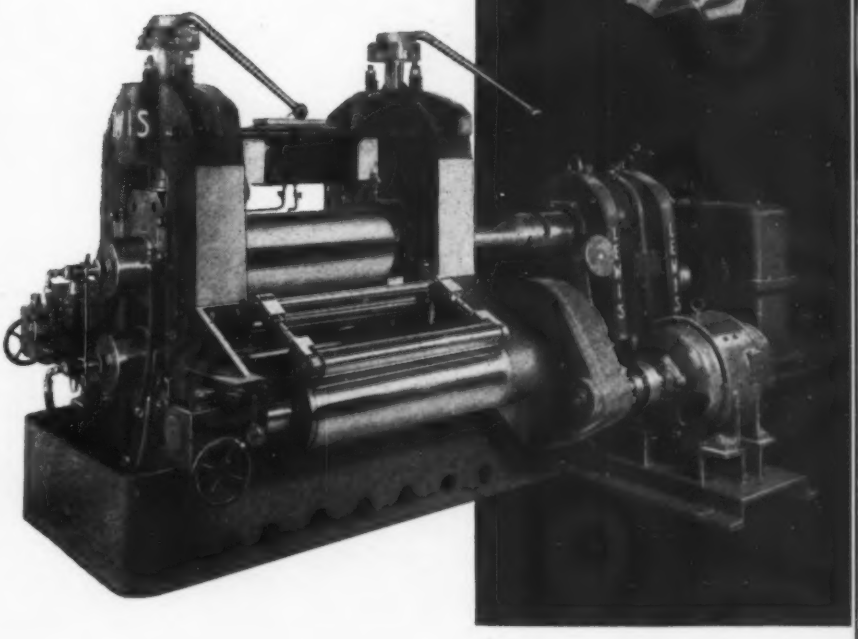
in manufacture is responsible for the unusually high output of

LEWIS FOIL MILLS

TWO-HI OR FOUR-HI

By working further back of the decimal point than is considered absolutely necessary, Lewis has provided foil producers with rolling equipment whose output can be figured in tons while its product is measured in thousandths of an inch.

An important feature of Lewis Foil Mills is the patented Automatic Tension Reel—adjustable to foils of any gauge...Write for complete data.



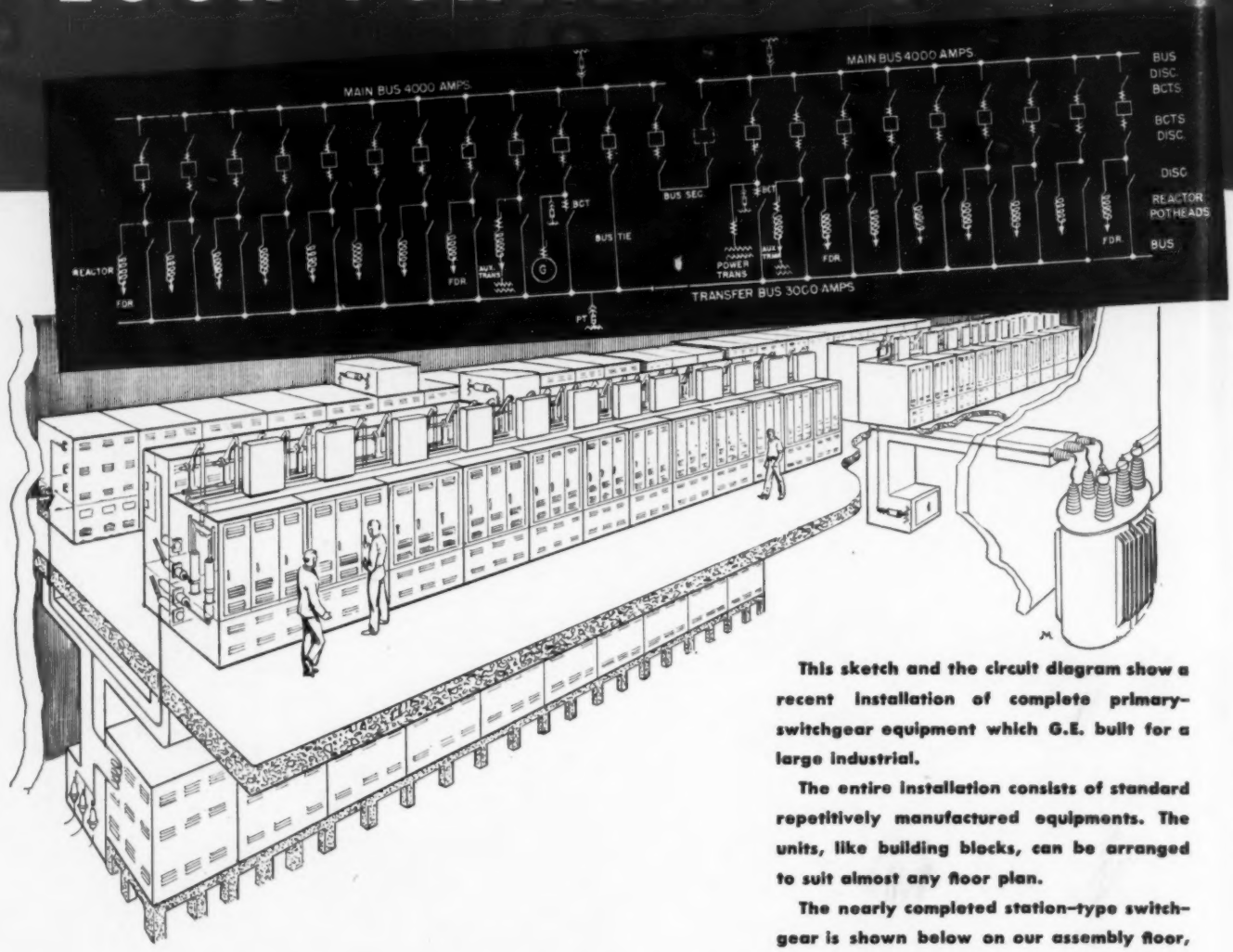
Top illustration . . . Lewis 13¼" x 34" Foil Mill showing view of wash pass. Unit Entering Side. Lower photo shows Leaving Side of similar mill.

LEWIS FOUNDRY & MACHINE

DIVISION OF BLAW-KNOX COMPANY, PITTSBURGH, PA.

1945

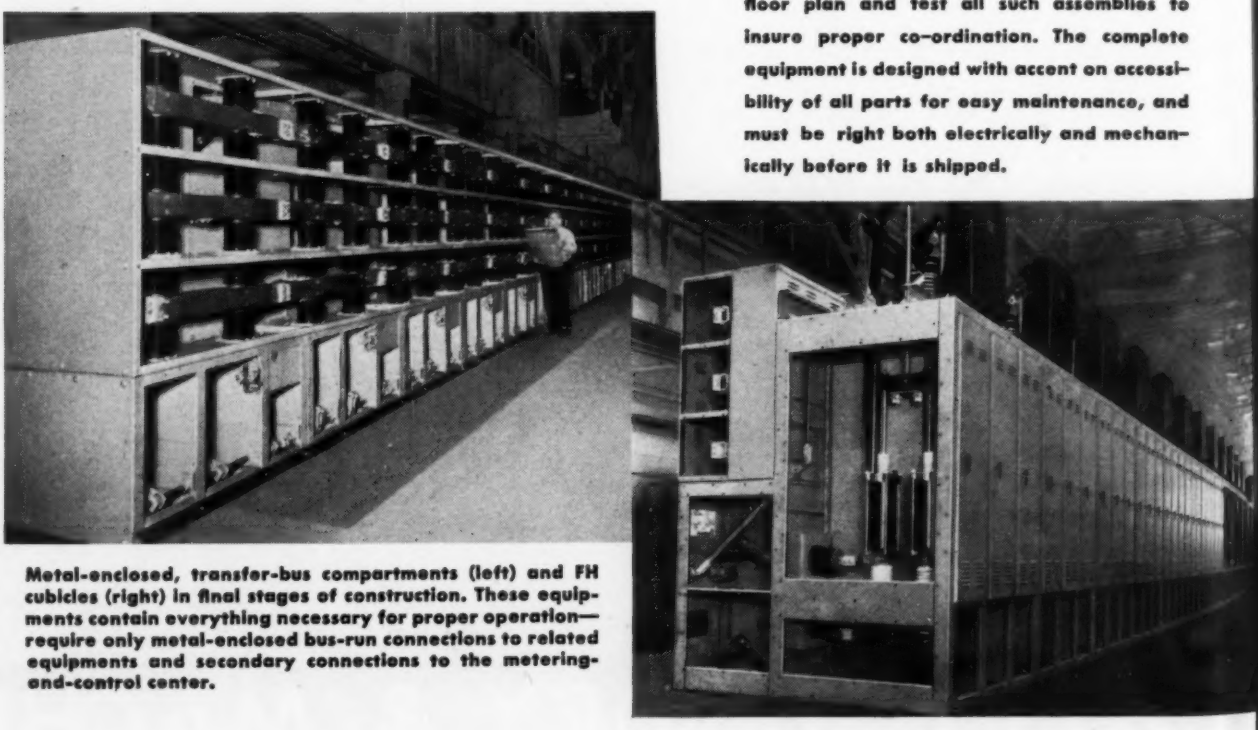
LOOK FORWARD TO THIS



This sketch and the circuit diagram show a recent installation of complete primary-switchgear equipment which G.E. built for a large industrial.

The entire installation consists of standard repetitively manufactured equipments. The units, like building blocks, can be arranged to suit almost any floor plan.

The nearly completed station-type switchgear is shown below on our assembly floor, where we duplicate the actual installation floor plan and test all such assemblies to insure proper co-ordination. The complete equipment is designed with accent on accessibility of all parts for easy maintenance, and must be right both electrically and mechanically before it is shipped.



Metal-enclosed, transfer-bus compartments (left) and FH cubicles (right) in final stages of construction. These equipments contain everything necessary for proper operation—require only metal-enclosed bus-run connections to related equipments and secondary connections to the metering-and-control center.

BUY WAR BONDS

TYPE OF SWITCHGEAR

It enables you to apply your most advanced thinking and do it at the lowest investment cost —

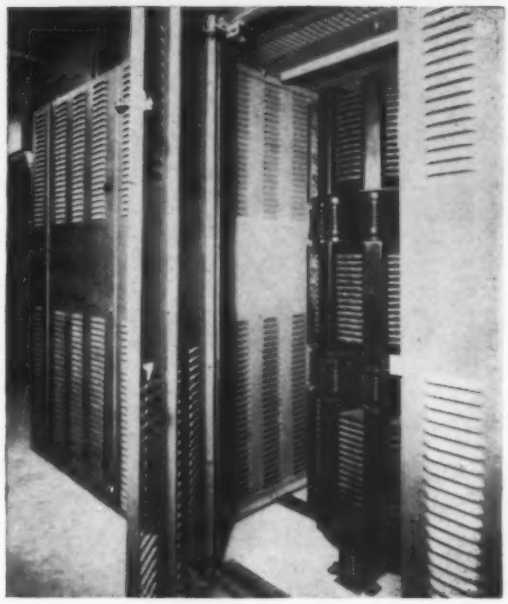
. . . for a station or even a whole system

THIS metal-enclosed primary switchgear, for circuits up to 33 kv, and with interrupting ratings up to 2,500,000 kva, is so designed that it can be factory-assembled in many standard combinations.

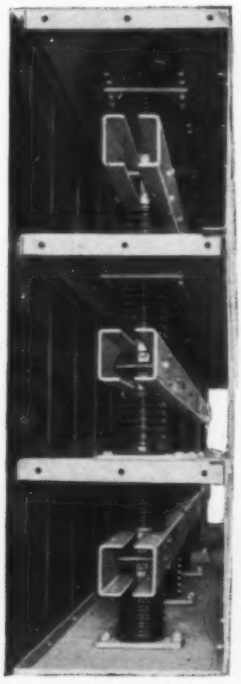
Its versatility enables you to meet almost any circuit arrangement and functional requirement with standard, repetitively manufactured equipment.

The same versatility permits you to make the best possible use of your available floor space. The basic units of equipment can be assembled in such a way, and the equipments so grouped and located, that, usually, major reconstruction or an addition to the building is not necessary. On new construction many purchasers, stimulated by the variety of factory-assembled combinations available, have made important savings by designing the building to fit an ideal arrangement of equipments.

Complete, standard G-E switchgear equipments are available for the high-voltage primary circuits and the low-voltage auxiliary circuits. Whether you are planning new construction or want to modernize an installation, ask your G-E representative how standard switchgear equipments can help you to provide better circuit protection, regulation, relaying, or control. *Apparatus Department, General Electric Company, Schenectady 5, New York.*



Metal-enclosed feeder-reactor compartments



Metal-enclosed, three-phase bus runs

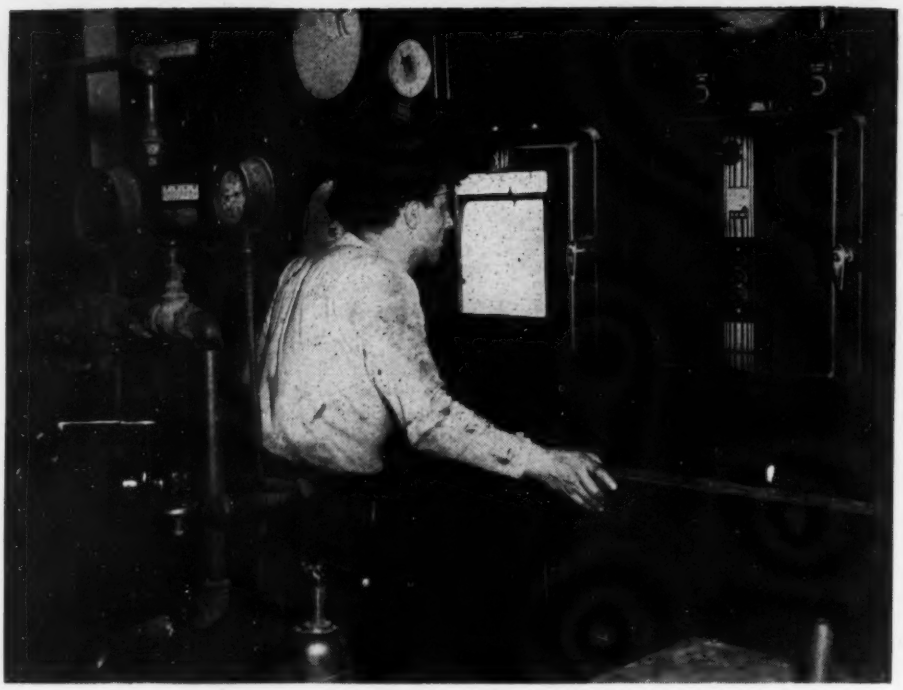
Metal-enclosed cable-entrance compartment with three-phase pothead

PACKAGED SWITCHGEAR

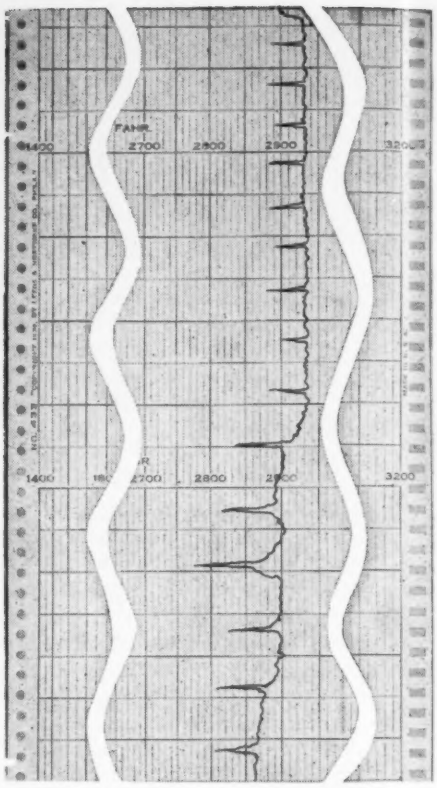
G.E. Builds with Steel

This ad appeared recently in electrical magazines to promote the use of metal-enclosed switchgear.

GENERAL ELECTRIC



First Helper in o-h shop of Erie Forge Company looks at Micromax Roof-Temperature Controller, which enabled him to set record of 400 melts in one campaign for furnace shown below.



Typical record, reduced, of Micromax Roof-Temperature Controller shown at left. Note points at which the Controller cut off oil fuel to prevent overheating roof.

O-H CAMPAIGN MAKES 400 HEATS As MICROMAX Control Saves the Roof

Over 400 melts of high-alloy open-hearth forging steel (far above the best previous record) were produced in the first campaign after the furnace above was equipped with L&N Control for roof temperature, combustion and reversal. This unit is one of three 65-ton o-h furnaces in the plant of Erie Forge Company, makers of heavy steel castings, forgings and forging ingot. All furnaces now have identical controls, as a result of the controller's performance on the one shown.

Erie Forge executives give the Micromax Roof Temperature Controller, which is just one element of the complete Control, full credit for saving the furnace roof and enabling the campaign to be extended so long, especially when making alloy steel with its long heats at high temperature.

But production men also point out that the stoppage of checkers, due to tar and dust, during so long a campaign, would have forced the furnace to shut down much earlier than it did, except for the automatic Combustion Control of fuel, air and furnace pressure.

And the very base of success of all operation, the Erie men feel, is the Micromax Automatic Reversal, which reverses the flow through the checkers on the basis of their temperature, and so levels out the operating and gives the other controllers a chance to be of greatest effectiveness.

If you have a specific problem in open-hearth control, an L&N engineer will be glad to work with you on it.

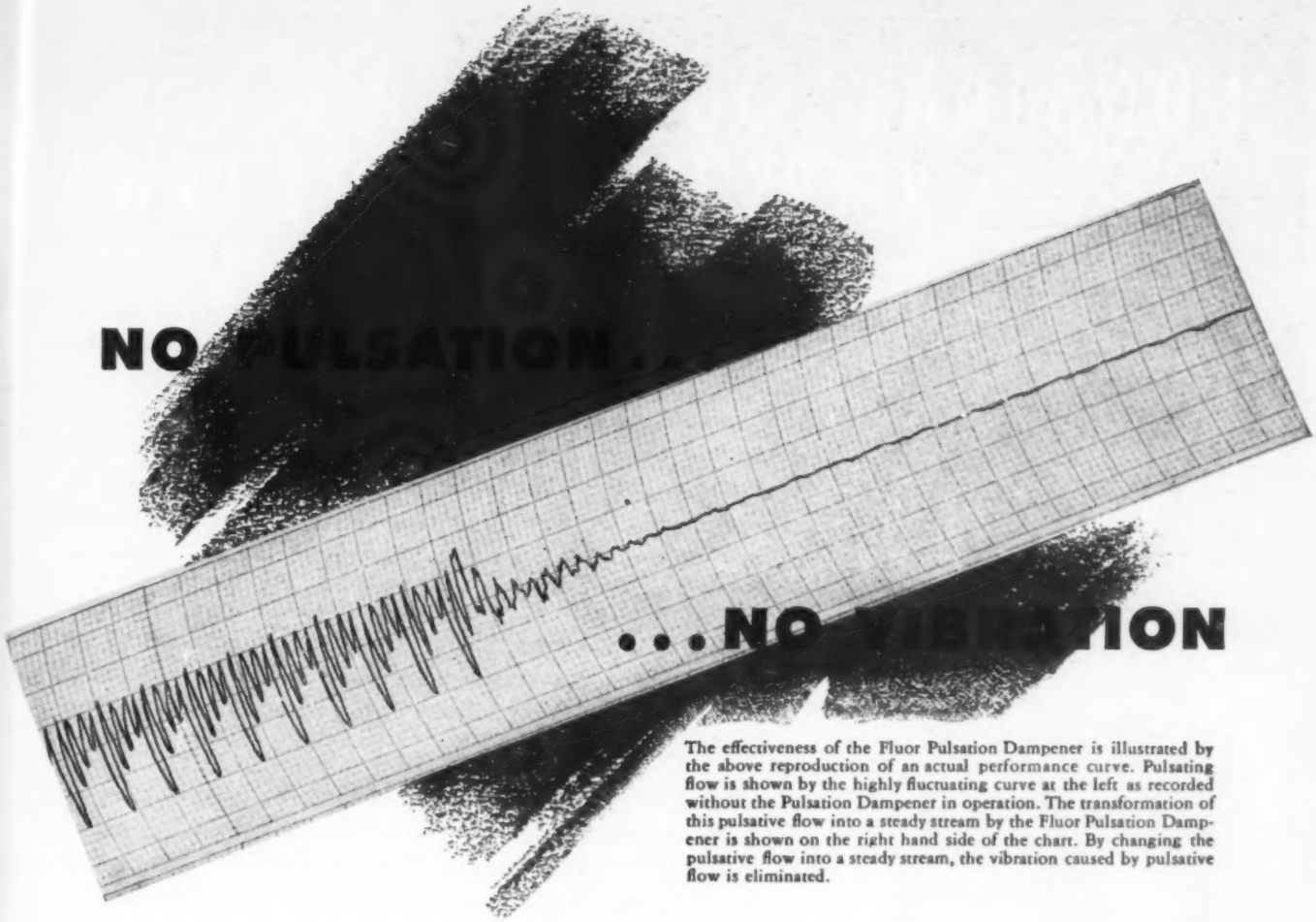
Micromax Roof-Temperature Control kept this 65-ton acid open-hearth furnace in operating condition for over 400 melts. Even then, roof was O.K., but checkers were so choked (note stings at doors) that rebuild was necessary.

LEEDS & NORTHRUP COMPANY, 4942 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl Ad B-33N-643(2)



The effectiveness of the Fluor Pulsation Dampener is illustrated by the above reproduction of an actual performance curve. Pulsating flow is shown by the highly fluctuating curve at the left as recorded without the Pulsation Dampener in operation. The transformation of this pulsative flow into a steady stream by the Fluor Pulsation Dampener is shown on the right hand side of the chart. By changing the pulsative flow into a steady stream, the vibration caused by pulsative flow is eliminated.

THE FLUOR PULSATION DAMPENER smooths pulsative flow into a steady stream in pipe lines carrying air, vapors or gases... regardless of engine speed, pressure or rate of flow. Designed for the *lowest* operating speed, it works even more efficiently as speeds are *increased*. No adjustments are necessary for higher frequencies. Constant maintenance necessary with mechanical dampeners is eliminated. Danger of line breakage from vibration is removed.

You can save on labor, materials and maintenance by specifying the FLUOR Pulsation Dampener on all new installations... and by installing it in your present lines where vibration is a constant problem and expense. Write for descriptive bulletin.

The FLUOR Pulsation Dampener is part of the piping system... not just a fixture. *Patents pending.*

BE SURE WITH FLUOR SINCE 1890

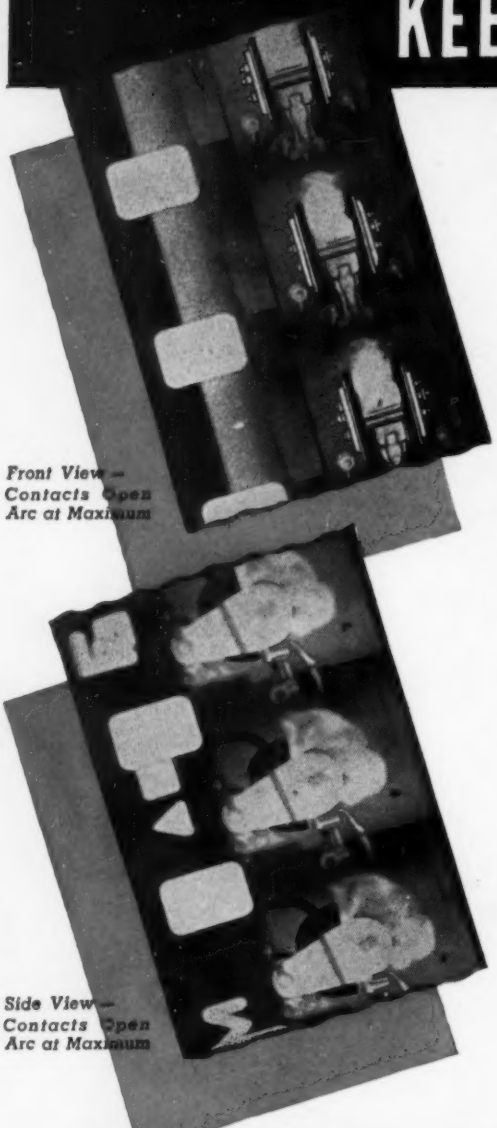
FLUOR

ENGINEERS • MANUFACTURERS • CONSTRUCTORS

PROCESS PLANTS AND EQUIPMENT FOR THE OIL, GAS AND ALLIED INDUSTRIES

THE FLUOR CORPORATION, LTD., 2500 S. Atlantic Blvd., LOS ANGELES 22 • New York, Pittsburgh, Kansas City, Houston, Tulsa, Boston

CONSTANT "3C" VIGILANCE KEEPS MAINTENANCE DOWN



Front View — Contacts Open Arc at Maximum

Side View — Contacts Open Arc at Maximum

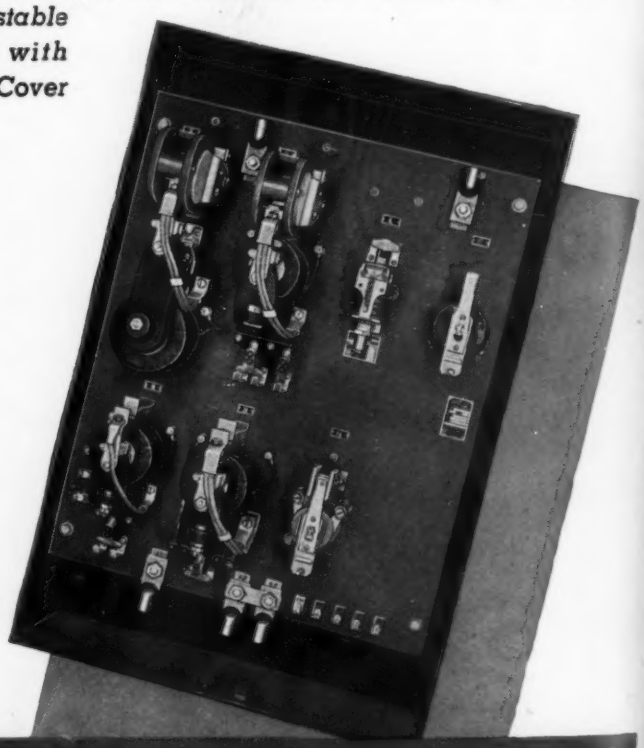
One of the many methods employed by The Clark Controller Company to cut electrical control maintenance costs is the use of high speed motion picture photography. A special camera takes action pictures at the rate of 8000 per second. Projected at normal speed, one second's action is slowed down to 8 minutes—permitting the close observation of operating characteristics which cannot be seen directly. Tiny light flashes on one edge of film accurately time the action.

The sections of film at left, recording three eight-thousandths of a second in the opening of the contact, demonstrate the efficiency of the arc shield on a Bulletin 7400 Contactor in quenching the arc and confining it to prevent "jumping over" to adjacent apparatus.

The Bulletin 7400 RD, D.C. Contactor is the heart of all our D.C. control apparatus. Combined with other "3C" devices it has made an enviable record in the operation of our entire line of D.C. Heavy Duty Starters.

★ ★ ★

Bulletin 5370, Size 5, Type B, Form 3AL, Non-reversing, Dynamic Braking, Adjustable Speed Starter with Type FL Relay. Cover Removed.



Bulletin 5730 D.C. Starter—Heavy Duty—Automatic—Reduced Voltage—Jogging Service —available in sizes from 10 H.P. to 200 H.P.— Can be supplied in Non-Reversing NEMA, ICIO-12-3A1, Non-Reversing Dynamic Braking NEMA, ICIO-3A2, and Reversing Dynamic Braking NEMA, ICIO-12-3A3 types.

Bulletin 5370 D.C. Starters, built around the sturdy Bulletin 7400 Contactor, give dependable operation with minimum maintenance.

THE CLARK CONTROLLER CO.

1146 EAST 152nd ST., CLEVELAND 10, OHIO • EVERYTHING UNDER CONTROL

ELECTRO-TECHNICAL PRODUCTS, INC.

Manufacturers of Resinous Coated Fabrics and Papers

NUTLEY 10, NEW JERSEY, U.S.A.

BRANCH FACTORIES: LOS ANGELES, CALIFORNIA LETCHWORTH, ENGLAND

Dear Mr. Electro Technician:

Re: Your Inquiry 10/26

Thank you for giving us this additional opportunity to tell you more information about the new process developed by ELECTRO-TECHNICAL for the base treatment of •FIBERGLAS electrical insulation fabrics.

A customary, or might we say a necessary procedure in the weaving of Glass Fabrics is to size the cloth with such materials as Dextrin, Starch, Sulphonated Oils etc., whose presence is not conducive to optimum dielectric results after the application of insulating varnishes. ELECTRO-TECHNICAL is the only manufacturer of resinous coated insulation fabrics, who is equipped on its own premises to remove these sizing substances from woven glass cloth, prior to the application of insulating varnishes.

The Pre Treatment components used on ELECTRO-TECHNICAL Glass Insulating Fabrics contain no electrolytes, and are absolutely neutral chemically.

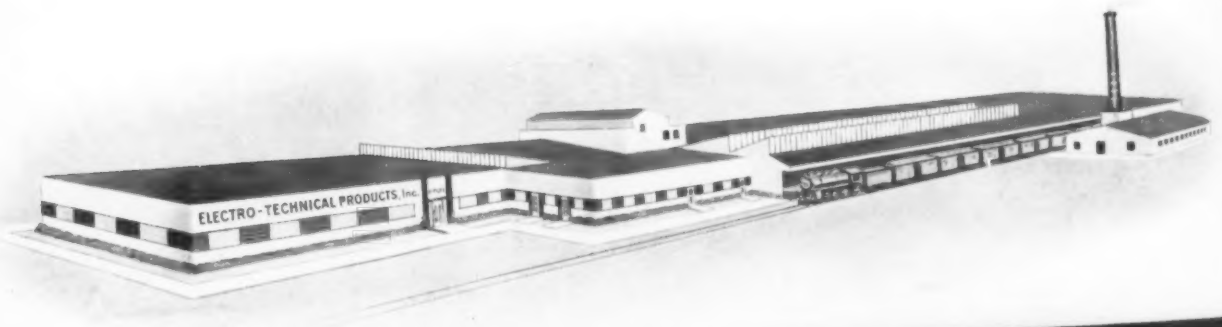
ELECTRO-TECHNICAL Pre Treatment also provides a greater degree of mechanical strength, higher insulation resistance and dielectric values, and a marked improvement has been noticed in resistance to moisture and corrosive chemical vapors.

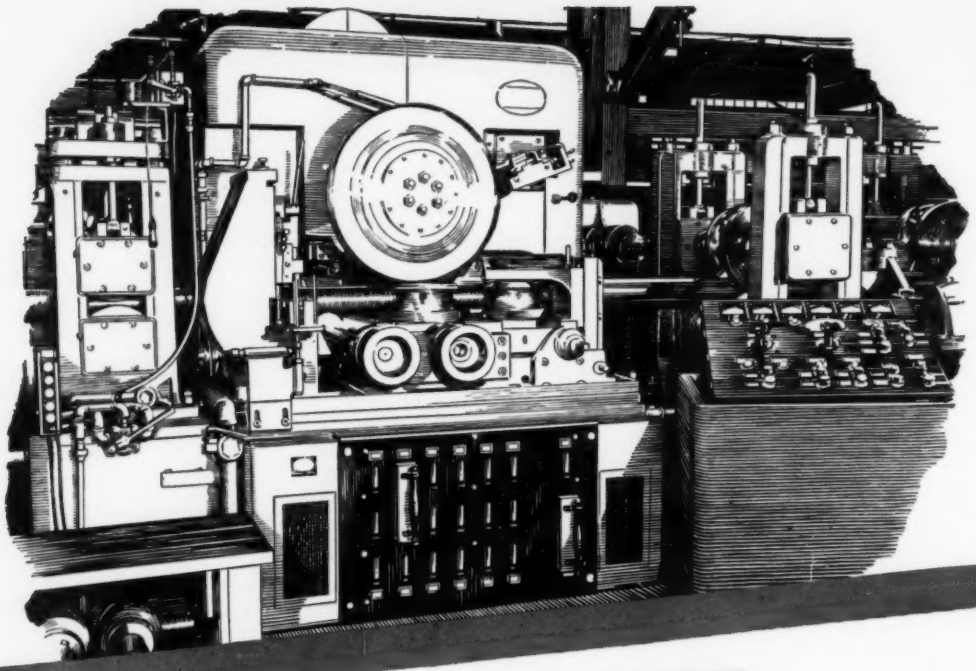
ELECTRO-TECHNICAL Pre Treatment Glass Insulation Fabrics remain more pliable over long periods of aging than ordinary varnished glass cloth. It is the ideal Class "B" winding insulation at no additional increase in price.

Very truly yours,

ELECTRO-TECHNICAL PRODUCTS, INC.

•—T.M. Reg. Owens Corning
Fiberglas Corp.





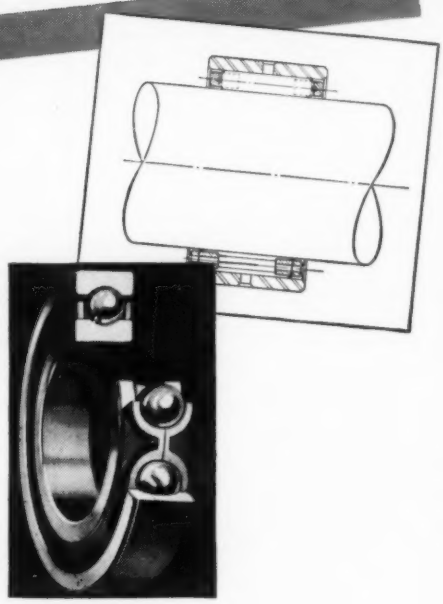
HELPING MAKE PIPE FOR AN INVASION LIFELINE

When plans were projected for the now famous invasion pipelines across the English Channel and up to the front lines to keep our mechanized armies well supplied with gas and oil, Yoder Tube Forming and Welding Machines, like the one shown above, were assigned the tremendous task of producing the many miles of pipe required. The pipe for this invasion lifeline was formed and welded by these Yoder tube mills in a continuous operation.

Sturdy, dependable Torrington Bearings are installed at strategic points in the Yoder Tube Machine, and provide smooth, trouble-free operation under severe conditions. The different types of Torrington Bearings are specifically designed to meet particular operating conditions. That is why so many roll-necks, back up rolls, screwdowns, reels, edgers and other steel mill machines run on Torrington Bearings.

The efficient performance of large, custom-built Torrington Bearings means operational savings in dollars and cents. It will pay you to investigate the many advantages of specifying Torrington Bearings in *your* product. The engineers of Torrington's Bantam Bearings Division are ready at all times to consult with you regarding your anti-friction problems, routine or unusual.

THE TORRINGTON COMPANY • BANTAM BEARINGS DIVISION
SOUTH BEND 21, INDIANA

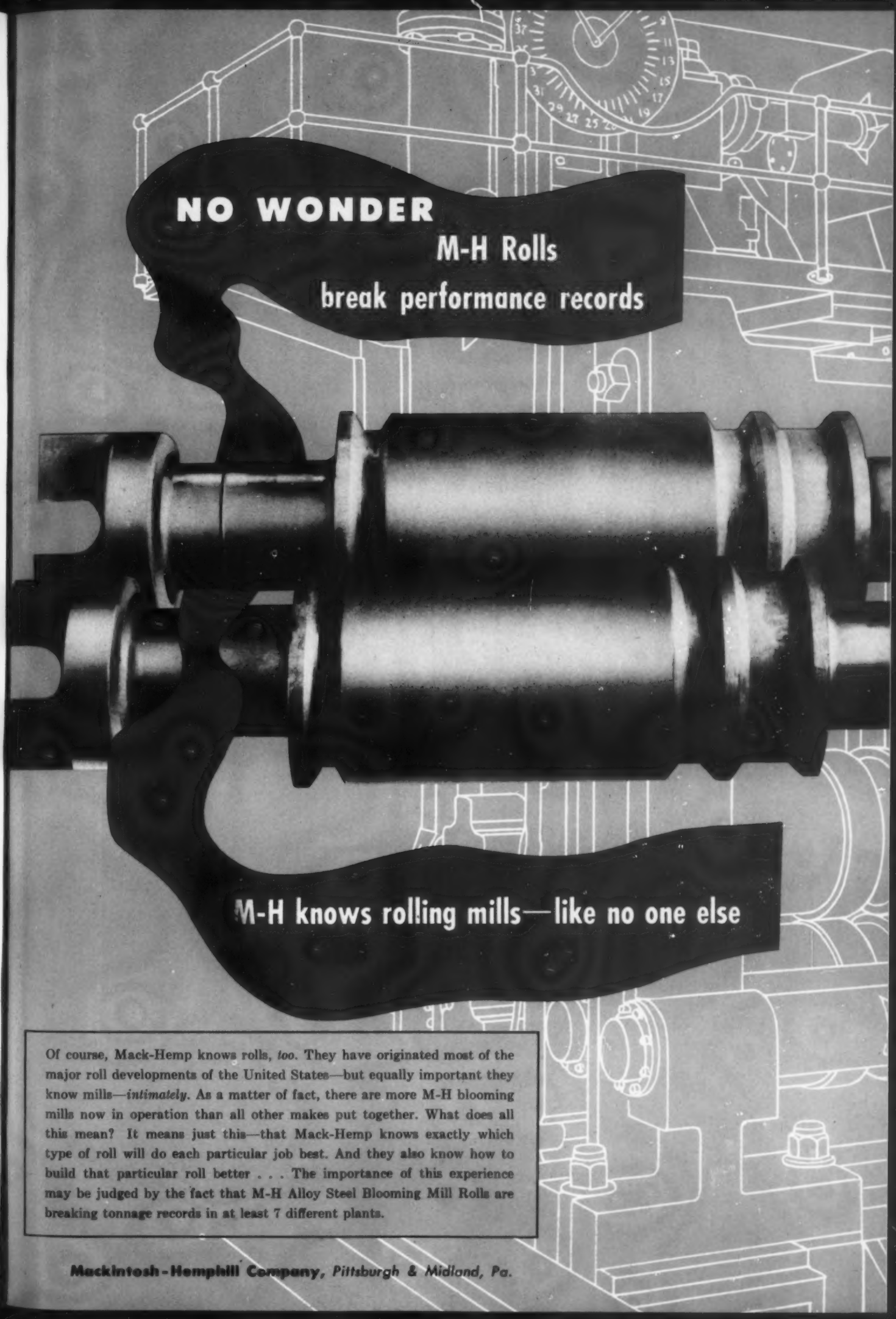


(Top)
Cross-section drawing shows construction of the type of Torrington Radial Roller Bearing used in the Yoder Tube Forming and Welding Machine. These bearings have a 3¼" O.D. and a 2 11-16" I.D. and assure smooth, trouble-free operation and easy, efficient lubrication.

(Photo)
Cutaway view of one of the Torrington Radial Ball Bearings which help to speed production of the Yoder Tube Machine. This type bearing is used in two sizes: 20" O.D. x 15" I.D. and 18" O.D. x 13½" I.D. Sturdy, long-life Torrington Bearings find a wide variety of applications in many types of heavy-duty equipment.

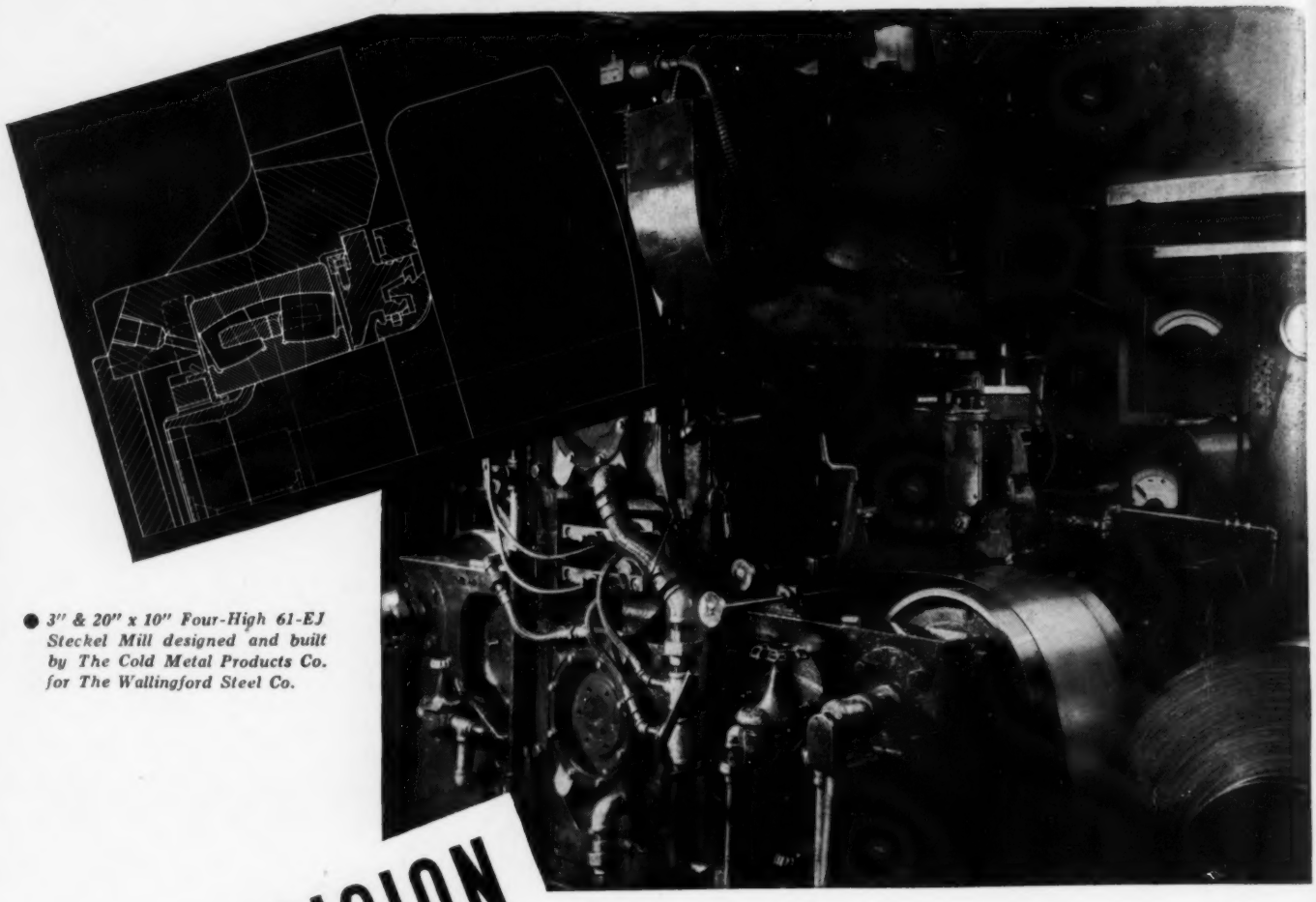
TORRINGTON BEARINGS

STRAIGHT ROLLER • TAPERED ROLLER • NEEDLE • BALL



Of course, Mack-Hemp knows rolls, *too*. They have originated most of the major roll developments of the United States—but equally important they know mills—*intimately*. As a matter of fact, there are more M-H blooming mills now in operation than all other makes put together. What does all this mean? It means just this—that Mack-Hemp knows exactly which type of roll will do each particular job best. And they also know how to build that particular roll better . . . The importance of this experience may be judged by the fact that M-H Alloy Steel Blooming Mill Rolls are breaking tonnage records in at least 7 different plants.

Mackintosh-Hemphill Company, *Pittsburgh & Midland, Pa.*



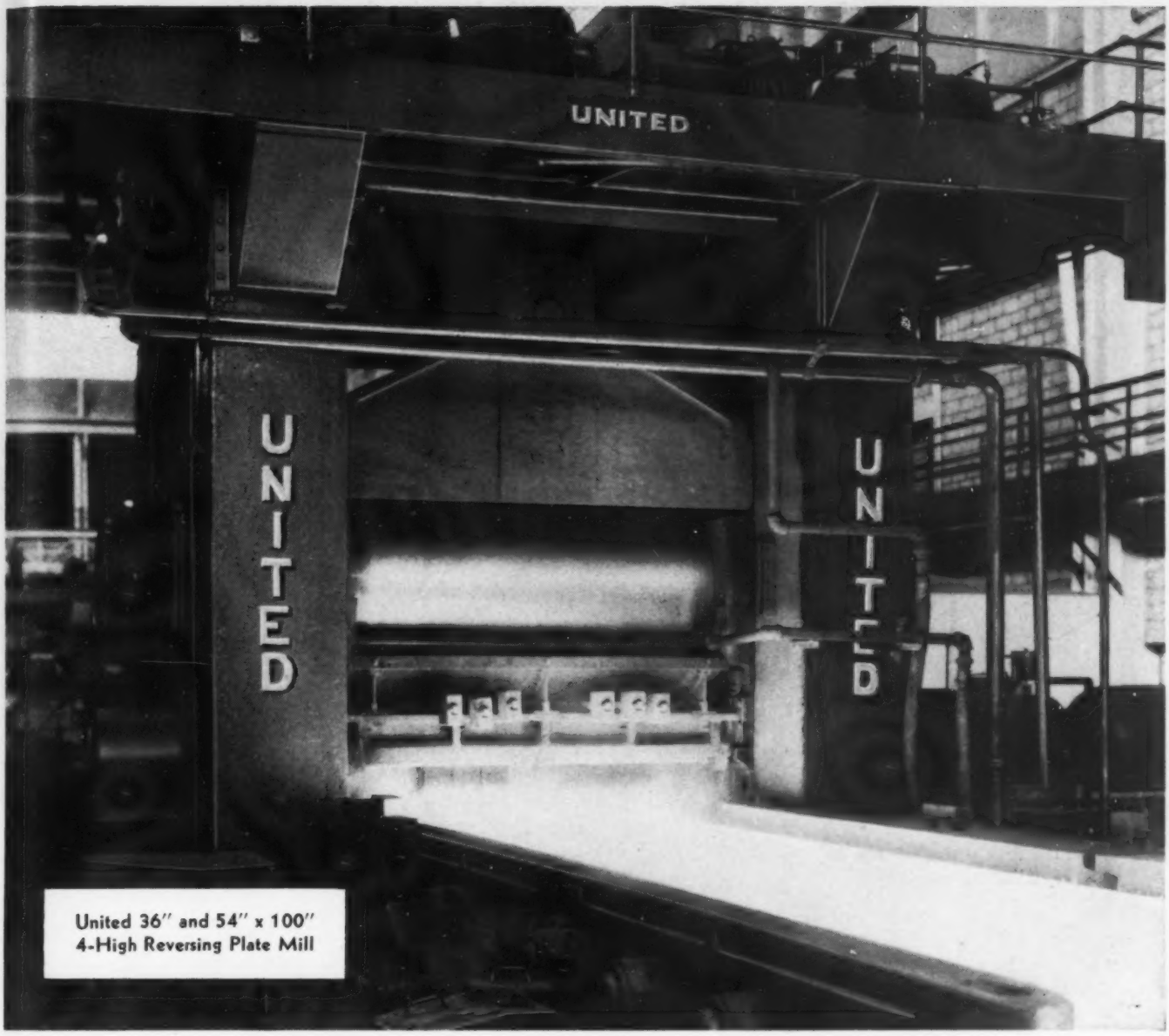
● *3" & 20" x 10" Four-High 61-EJ Steckel Mill designed and built by The Cold Metal Products Co. for The Wallingford Steel Co.*

PRECISION

ROLLING AT 2500 F.P.M.

On this mill, SKF Spherical Roller Bearings have built-in aligning characteristics that assure maximum load carrying capacity. Because the inner rings are driven up on tapered necks they do not creep and wear the necks. Gage variation and corrective maintenance are eliminated. With SKF Bearings and Back-Up Chucks, uninterrupted production of light gage high carbon strip goes on month after month without crown or gage variation from end to end of coil at speeds of 2500 feet per minute. 5910

SKF INDUSTRIES, INC., PHILA. 34, PA.



United 36" and 54" x 100"
4-High Reversing Plate Mill

UNITED 4-High Reversing Plate Mill

The 4-high reversing stand pictured above is the first ever installed in a tandem mill. It reduces a slab to the desired size for finishing in from 3 to 7 passes, at speeds up to 754 feet a minute.

Among numerous outstanding features embodied in its design is the electrical control mechanism which automatically makes required changes in roll settings for each pass, and reverts again to the initial setting for another cycle when the slab advances to the finishing train.

A system of roll balancing is employed that makes disconnection of hydraulic connections unnecessary when backup roll changes are required.

The "know-how" that built this mill is the result of many years progressive research and development in rolling mill design and construction. To the industry, we offer the advantages of that experience plus the manufacturing capacity of our 6 great plants.

The World's Largest Designers and Makers of Rolls and Rolling Mill Equipment

UNITED ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

Plants at **Pittsburgh • Vandergrift • New Castle • Youngstown • Canton**

Subsidiary: Adamson United Company, Akron, Ohio

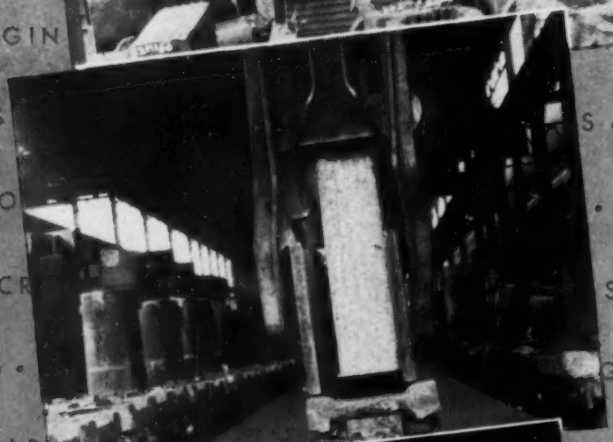
Affiliates: Davy and United Engineering Company, Ltd., Sheffield, England

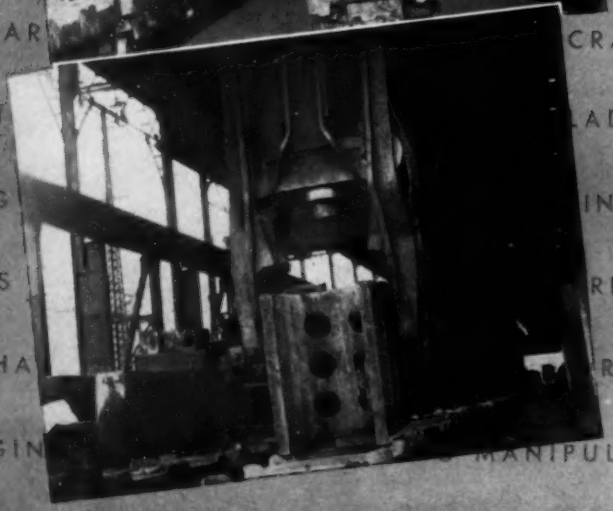
Dominion Engineering Works, Ltd., Montreal, P. Q. Canada

WORLD'S LARGEST BUILDERS OF THE

world's largest cranes

STRIPPER CRANES





TOP—200 ton low head room push-pull screw type stripper removing mould from 20 ton ingot.

CENTER—Above stripper using stool loosening device with ingot gripped and raised by the extracting tongs.

BOTTOM—Exposed view of stool loosener showing projection on stripper links which holds down E shaped steel loosener.

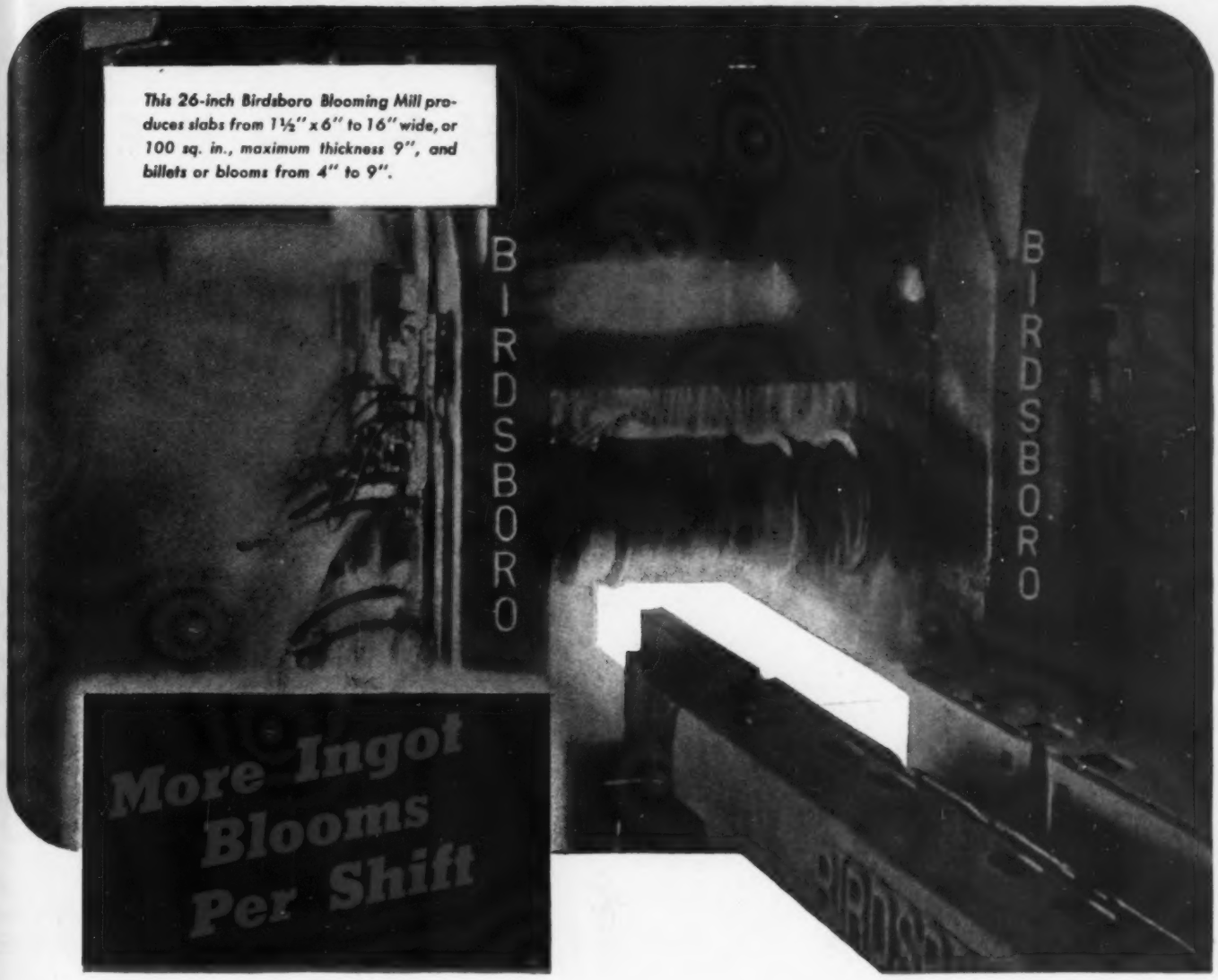
ARMY E NAVY

Alliance

THE ALLIANCE MACHINE CO.

ALLIANCE, OHIO

PITTSBURGH OFFICE • 1622 OLIVER BUILDING


This 26-inch Birdsboro Blooming Mill produces slabs from 1½" x 6" to 16" wide, or 100 sq. in., maximum thickness 9", and billets or blooms from 4" to 9".
BIRDSBORO
BIRDSBORO
More Ingot Blooms Per Shift

with Birdsboro Rapid Two-High Reversing Blooming Mill . . .

for blooming ingots of mild, tool, non-corrosive, automotive, aircraft and special purpose steel

to square, round and rectangular blooms and slabs

with the proper reductions required by the various grades of metals

within time limits the rolling temperatures permit.

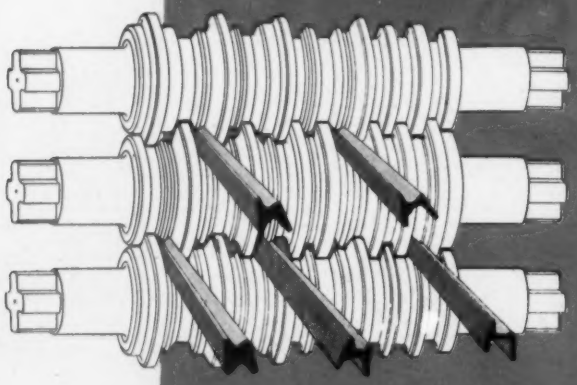
Special features of this Birdsboro Rolling Mill—quick reversing, fast screw-down and rapid manipulation—provide the exceptional speed that is demanded by war-pressed production. Yet their low installation cost, low maintenance cost and low power consumption assure the economy that will be needed after Victory is achieved.

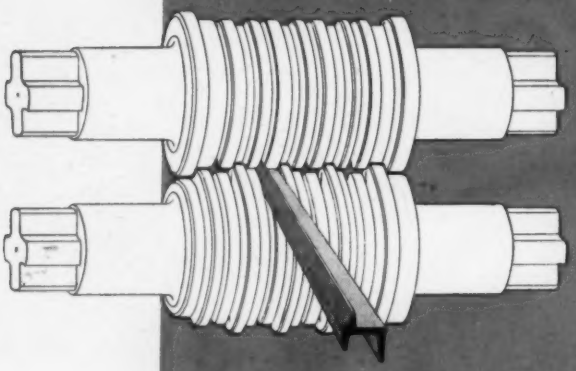
If yours is a rolling problem—of either the present or future—it will pay you to consult Birdsboro.

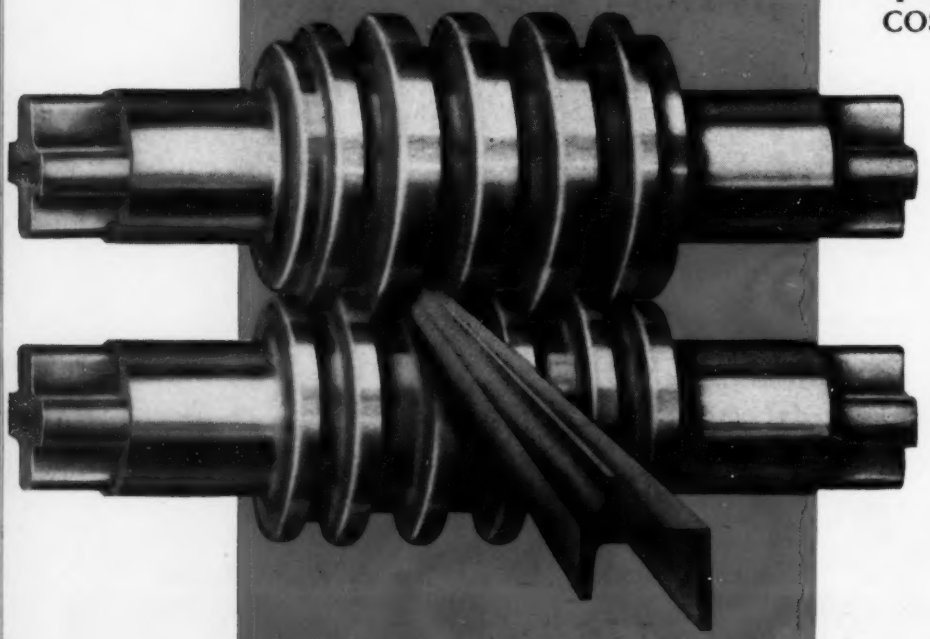
BIRDSBORO STEEL FOUNDRY AND MACHINE COMPANY, Birdsboro, Pa.

BIRDSBORO
STEEL MILL EQUIPMENT

ROLLING TECHNIQUE . . .







Special Shapes

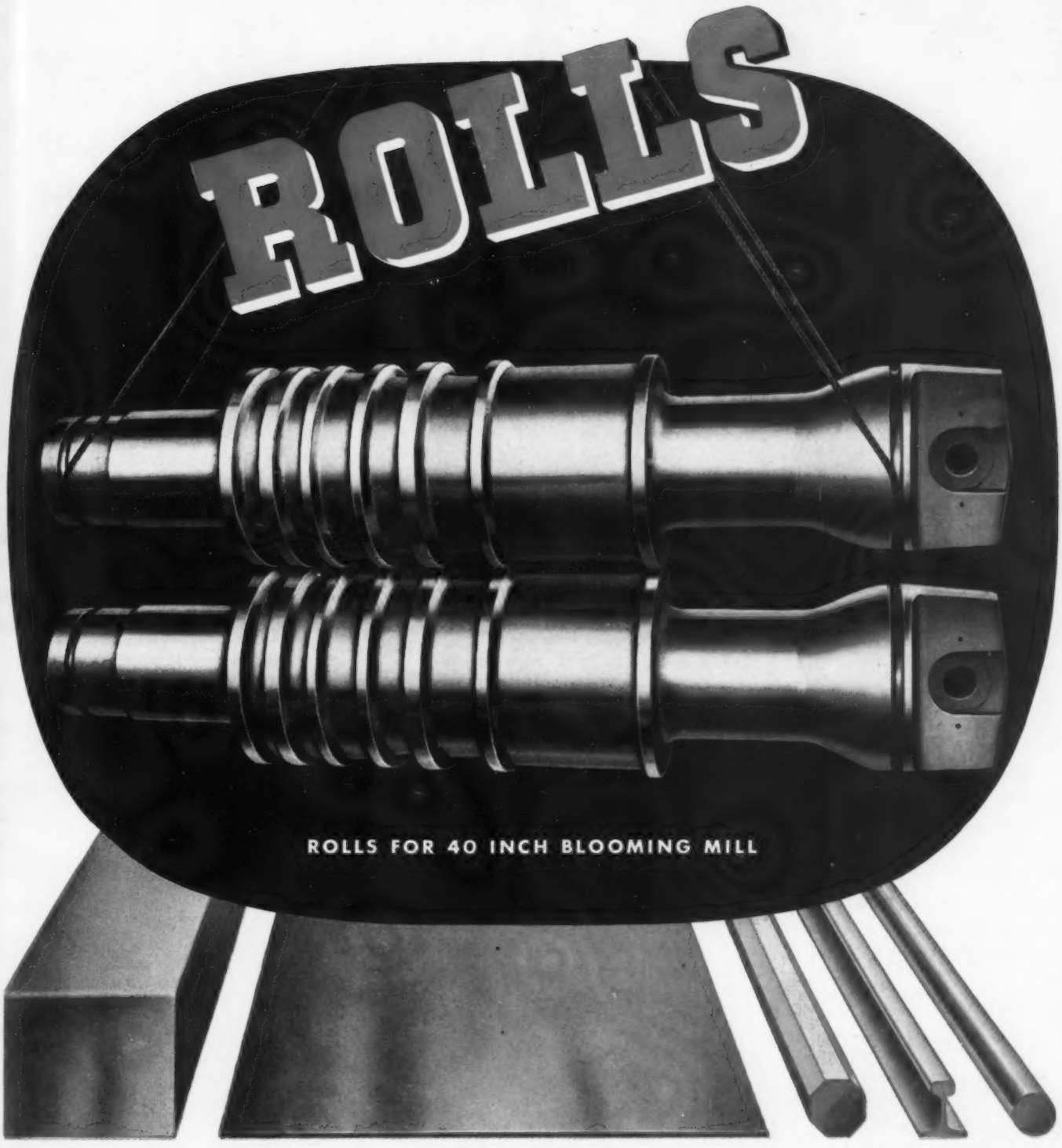
With astonishing variety, the rolling mill of today turns out special shapes and sections that would have been left to slower, more expensive methods or not attempted at all a few short decades ago. Each of these hundreds of various sections requires special characteristics in a roll to do each special job.

Pittsburgh Rolls, with three-quarters of a century of roll-making experience and satisfactory performance behind them, can be relied on to deliver the production of highest quality for which high speed modern mills are designed at LESS COST PER TON OF STEEL ROLLED.

PITTSBURGH ROLLS
Division of Blaw-Knox Company
PITTSBURGH, PA.

PITTSBURGH ROLLS

CONTINENTAL



ROLLS FOR: BLOOMS, BILLETS, BARS, MERCHANT BAR, PLATE, RAILS, ROD, ROUNDS, SHEETS, SKELP, STRIP, STRUCTURAL SHAPES, TIN PLATE.

CONTINENTAL *FOUNDRY & MACHINE COMPANY*

CHICAGO • PITTSBURGH

CHICAGO WORKS, EAST CHICAGO, INDIANA

PITTSBURGH WORKS, CORAOPOLIS, PA. • WHEELING WORKS, WHEELING, W. VA. • WARWOOD WORKS, WHEELING, W. VA.

MONEY

IS LOST WITH EVERY CHIP IN MANUAL CONDITIONING OF STEEL BILLETS . . . .

CHIPPING AWAY PROFITS

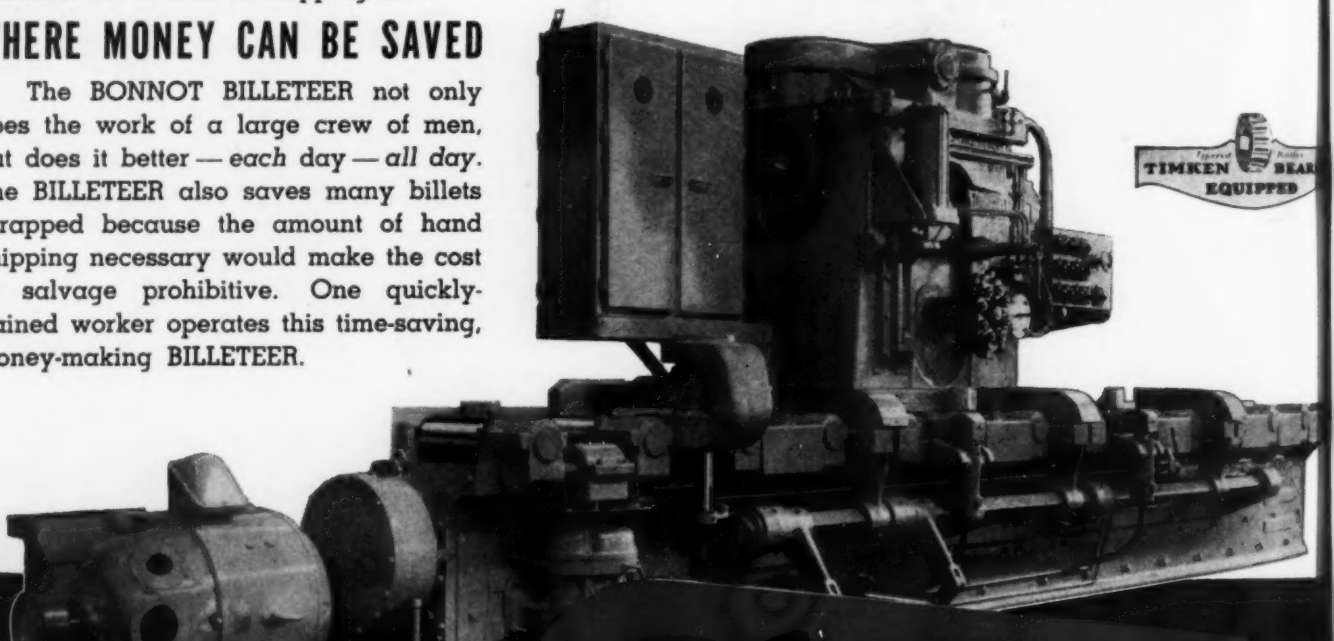
Industry is always seeking better and faster ways of doing things — of cutting corners in production costs. Management knows this is the way to profits. In the conditioning of steel billets, the BONNOT BILLETEER saves time, manpower and materials. The BILLETEER cleans a dozen billets while a man is chipping one.

WHERE MONEY CAN BE SAVED

The BONNOT BILLETEER not only does the work of a large crew of men, but does it better — *each* day — *all day*. The BILLETEER also saves many billets scrapped because the amount of hand chipping necessary would make the cost of salvage prohibitive. One quickly-trained worker operates this time-saving, money-making BILLETEER.

Write . . . today for complete BONNOT BILLETEER DATA.

FOR TOP STEEL MILL EFFICIENCY
. . . BONNOT'S THE BUY!



MECHANIZE YOUR BILLET CONDITIONING NOW. PREPARE FOR TOMORROW'S INTENSIFIED COMPETITION.

Engineered FOR [illegible] PRODUCTION

Bonnot

THE BONNOT COMPANY

BUILDERS OF **THE BILLETEER**

CANTON 2, OHIO

ADDRESS CORRESPONDENCE TO

STEEL EQUIPMENT DIVISION

25 Kva - 2400 △ /4160 Y Volts High Voltage— 240 x 480 Volts △ Low Voltage

50 Kva - 12,000 Y - 240 x 480 Y Volts Low Voltage

Pennsylvania

3-PHASE O. I. S. C. DISTRIBUTION TRANSFORMERS

250 Kva Auto Transformer. 2300 Y - 3100 Y Volts

For Industrial or Residential Service

These transformers, being low and compact, require minimum space for installation.

The oval tank provides a structure of inherent strength and rigidity. Tank shell, radiator tubes and cover are made of heavy gauge copper-bearing steel. Covers are domed to shed water. The flanged, outer edge of the cover protects the gasket and adds further mechanical stability to both tank and cover.

Construction shown is used for ratings from 15 Kva up to and including 200 Kva—15,000 volts. Standard units are furnished completely sealed and equipped for either pole or platform mounting.

For further information on these and other types of distribution or power transformers, contact your nearest Pennsylvania Representative or write direct to Pennsylvania Transformer Company.

Pennsylvania TRANSFORMER COMPANY

Pennsylvania TRANSFORMERS

808 Ridge Avenue, N. S., Pittsburgh 12, Pa.

No. 12 of a Series: "Looking at the FIVE ESSENTIAL THINGS you never see in ELECTRODES!"

Extruding an electric-furnace electrode. Sixty years of experience, guided by continuing research, enables National Carbon Company to make electrodes of unmatched quality.

MATCHING STRIDES WITH STEELMAKERS

Under the stimulus of war, the steel industry has developed new techniques to attain new highs in efficiency. The industry is thus better equipped to meet the challenge of the days to come.

Matching strides with the steelmakers, National Carbon Company, Inc. . . . through continuing research . . . also successfully rose to meet this war crisis. Carbon and graphite electrodes performed as never before.

And now in the days to come, continuing research—one of the "five essential things you never see" in electrode-manufacture*—will continue to help us to parallel the progress of steel by turning out ever stronger, more uniform electrodes.

• • •

*These "five essential things you never see" in electrodes are: selection of raw materials, manufacturing experience, manufacturing control, continuing research, and customer service. They are a part of every "National" and "Acheson" electrode. We shall be glad to explain in detail how they can be of distinct advantage to you.

NATIONAL CARBON — ACHESON GRAPHITE

The words "National" and "Acheson" and the "National" and "Acheson" Seals are registered trade-marks of National Carbon Company, Inc.

NATIONAL CARBON COMPANY, INC.
Unit of Union Carbide and Carbon Corporation
UCC
GENERAL OFFICES: 30 East 42nd Street, New York 17, N.Y.
DIVISION SALES OFFICES: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco
In Canada: Canadian National Carbon Company Limited, Toronto 4, Canada

The research job they did years ago

is saving industry thousands of maintenance dollars today

OVER a decade ago, Airco's research engineers developed a new process for cleaning and dehydrating steel surfaces with the oxyacetylene flame . . . a simple, inexpensive way to make new paint last longer on steel structures. Today, this modern flame cleaning process has become an established time-saving maintenance method for bridges, storage tanks, signal towers, and all forms of structural work.

This Airco research achievement is only one of many time- and cost-saving techniques originated in Airco research laboratories. Other equally promising innovations are now in development — in accordance with Airco's constant purpose of increasing oxygen's usefulness to industry.

• An interesting free booklet — "Oxygen — Indispensable Servant of Industry" — describes recent Airco research developments and other phases of Airco's *complete* oxygen service. For a free copy, write to Dept. IS at the New York office.

AIR REDUCTION AIRCO

General Offices: 60 E. 42nd St., NEW YORK 17, N. Y.

In Texas: Magnolia Airco Gas Products Co. • General Offices: Houston 1, Texas

Offices in all Principal Cities

AIRCO OXYGEN GUARANTEED 99.5% PURE IN THE CYLINDER

Two of four 15-ton, 120-foot span all-welded Cleveland Cranes in the Cold Reduced, Hot Strip Finishing and Shipping Departments of a large steel mill. The cranes are controlled from a cab at center of the bridge and travel at a speed of 500 F.P.M.

THE CLEVELAND CRANE & ENGINEERING CO.

1131 EAST 283 RD ST. WICKLIFFE, OHIO

CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

Crops *and* Shorts

THE Surplus Property Administration has announced that prospective earnings will be the primary yardstick in fixing prices of government-owned surplus steel plants, rather than original cost. Unusual risk involved in new steel producing areas and factors affecting the general economy will also be vital considerations. Each plant will be considered separately, and some plants may be leased if their special problems make a sale less desirable.

▲

IT seems that many countries are fighting for freedom from the freedom for which they last fought — or is it that some people's idea of freedom is merely status quo — or maybe the milk of human kindness is the evaporated type.

▲

THROUGH a survey of the 44,000 employees who left their jobs to serve their country, Carnegie-Illinois Steel Corporation has learned that, on the basis of the first 7000 replies, 88 per cent plan to return to the company, 9.6 per cent are undecided, and the remainder do not intend to return.

▲

ADD to reconversion assists: The coal strike is estimated to have reduced October steel production about 800,000 tons. WPB swan song states that this year's production goals will be thrown out of kilter unless labor-managements are cleared up very soon. And the labor-management conference in Washington was ushered in by a District of Columbia transportation strike.

▲

AN interesting bit of recent news is the report that the A. F. L. and C. I. O. receive $700,000 from the Red Cross and War Fund drives to defray the expense of solicitation of their 15,000,000 members Industry used to do this free, and at the same time reaped a lot of criticism from its workers for doing it.

▲

STATISTICS are reported showing that Washington and Reno are the hardest drinking cities in the United States. Looks as though election and rejection call for lots of spiritous support.

▲

THE steel industry is unanimous in asserting that a general wage jump of $2 a day is not in the cards without an increase in ceiling prices, that there should be a price rise averaging $7 per ton because of past increases in production costs, and that there are no concealed or secret profits.

The effect of wage increases varies between industries and even between companies in the same industry. The portion of total processing costs made up by wages and salaries ranges from 25 to 60 per cent — it is 57.4 per cent for steel. A general boost of 15 per cent cannot be absorbed under present price ceilings without putting many companies completely out of business and seriously handicapping the rest in their efforts to maintain production and provide jobs.

▲

SOMETIME ago on this page we mentioned a reader's plaint that too much of our engineering is by precedent. Comes now another reader to state that it "ain't necessarily so," and points to air-conditioned trains, which he claims came about because engineering couldn't open railroad car windows.

▲

WE have requests for A. I. S. E. Yearbooks for 1940, 1942 and 1944 which cannot be filled because of exhaustion of our stock. Likewise, stocks of the monthly Iron and Steel Engineer for January through July, 1945, have been exhausted. Should there be any of these issues for which the owner has no use, we would appreciate his communicating with the Association of Iron and Steel Engineers, 1010 Empire Building, Pittsburgh 22, Pennsylvania.

▲

IF any of our readers are inclined to feel prosperous because of an accumulation of war bonds or other assets, it might be well to recall that the federal debt is now close to $280,000,000,000 — about $2000 per individual.

▲

THIRD-QUARTER financial reports show net income of the steel industry lower than in the preceding quarter. In some cases the actual net would have been even lower had tax adjustments not been allowed. The drop is variously attributed to termination of war contracts, higher costs, reduced volume and strikes.

▲

COLUMBIA Steel Company is proceeding with a $25,000,000 expansion at Pittsburg, California, and is reported to be considering another $25,000,000 expenditure at Torrance. Bethlehem Steel Company has announced an $8,000,000 project at Los Angeles, to be followed soon by another $8,000,000 expansion. Kaiser's plans call for an expenditure of $11,500,000 for plant equipment to round out facilities for peacetime products. It would seem that there will be no lack of competition for western steel business.

▲

AFTER more than seven months of deliberation the Supreme Court brought forth a 5-4 decision acquitting 24 former German-American Bund members who had been convicted in lower courts of advising evasion of the Selective Service Act — and now the court is going to review Esquire pictures in the government's case against that publication.

▲

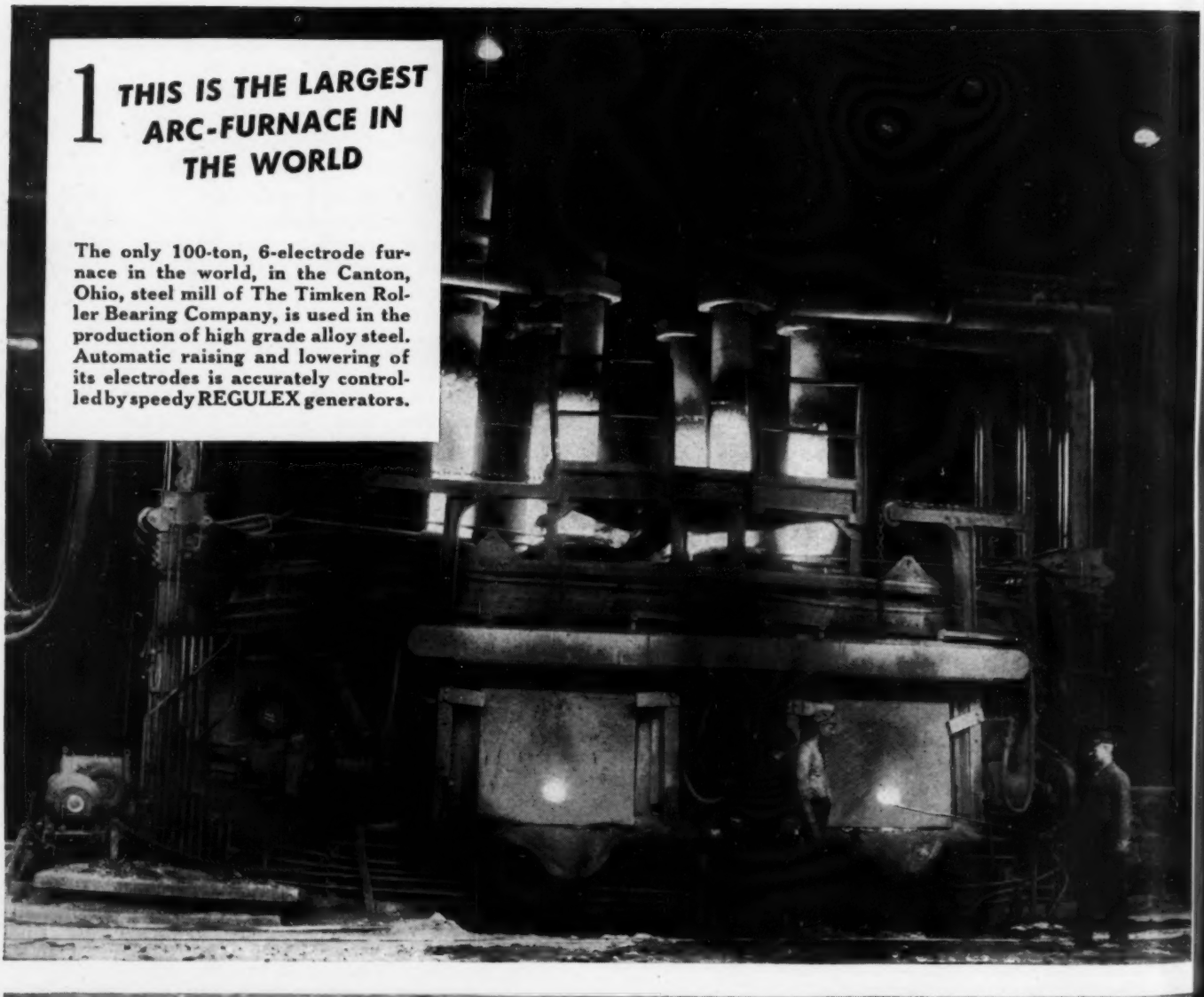
THE steam turbine is said to be the source of two-thirds of the electric power generated in the United States.

TIMKEN ROLLER BEARING CO. ADOPTS CONTROL FOR WORLD'S

Here's story of how The Timken Roller Bearing REGULEX arc furnace control on all production ... saves money with other Allis-Chalmers furnace

1 THIS IS THE LARGEST ARC-FURNACE IN THE WORLD

The only 100-ton, 6-electrode furnace in the world, in the Canton, Ohio, steel mill of The Timken Roller Bearing Company, is used in the production of high grade alloy steel. Automatic raising and lowering of its electrodes is accurately controlled by speedy REGULEX generators.



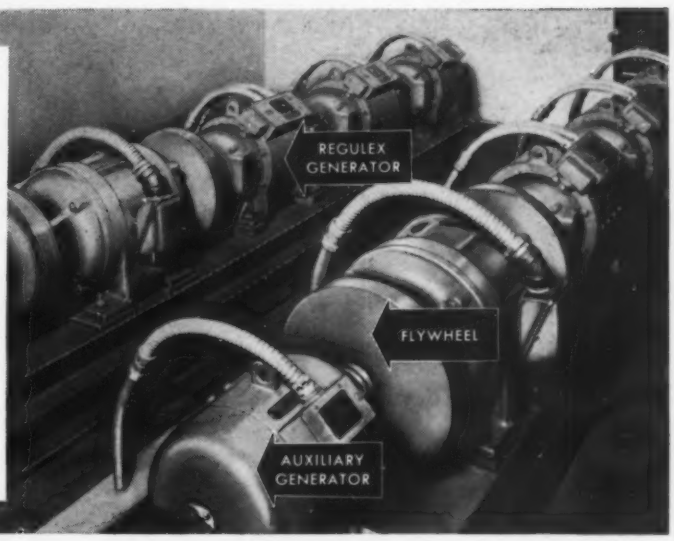
ALLIS CHALMERS MILWAUKEE 1, WISCONSIN

FAST-ACTING REGULEX LARGEST ARC FURNACE

Company saves time and trouble by using accurate furnaces, including world's only 100-ton unit equipment which can give you the same benefits.

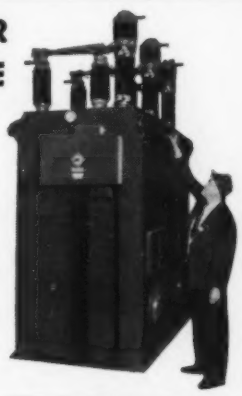
2 THESE ARE THE MACHINES THAT REGULATE IT

Installation of these twin REGULEX control sets for control of their 100-ton furnace resulted from The Timken Roller Bearing Company's successful experience with REGULEX control on a smaller, 60-ton furnace. The operators found, for example, that the REGULEX system gave closer control at all currents . . . thus reduced both meltdown time and electrode breakage. In addition, they liked the flywheel — for automatically raising electrodes upon a power shut-off — and the auxiliary d-c generator. On the strength of such proven superiority, the company decided to equip all 7 of their arc furnaces with REGULEX control.

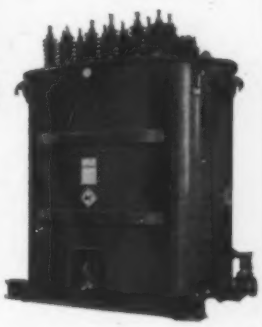


3 HERE IS THE AIR BLAST FURNACE SWITCH

Allis-Chalmers' 34,500 volt air blast switch is used as the operating switch for one furnace, and is backed up by an A-C outdoor oil circuit breaker, handling primary faults only. This arrangement eliminates oil circuit breaker maintenance! The Timken Roller Bearing Company finds it "the logical scheme" for arc furnace switching.



4 ..AND HERE IS THE FURNACE TRANSFORMER



Supplying power to a 70-ton furnace in The Timken Roller Bearing Company's steel mill is this 12,000 kva Allis-Chalmers transformer. A-C transformers are especially designed to withstand the heavy mechanical and electrical stresses of arc furnace duty.

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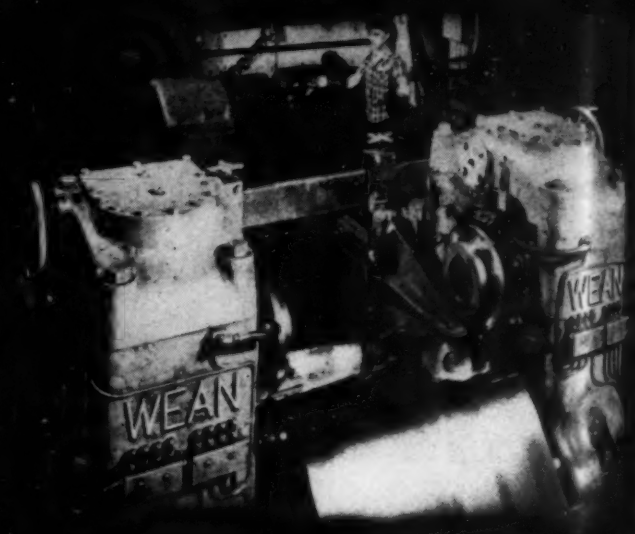

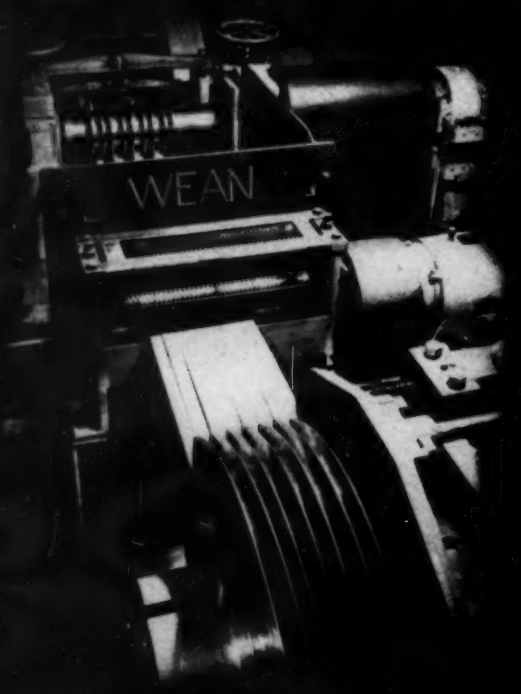

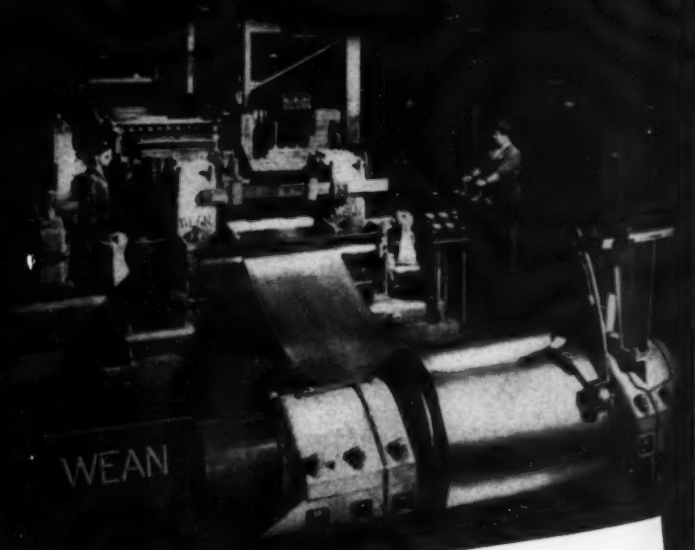

THE WEAN ENGINEERING CO., INC.
WARREN, OHIO

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Cooling Beds AND Transfers

. . . . the selection of the correct cooling bed, with the flexibility to meet all operating requirements, requires careful analysis . . . . several modern installations are described in detail . . . .

by Charles L. Raisig

MECHANICAL ENGINEER

MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

▲ COOLING beds and transfers are mill elements which are becoming increasingly important as special handling becomes necessary with different steels. The beds installed must be able to handle the product satisfactorily. In all cases a straight product leaving the bed is desired. It may be necessary to get the material off the bed or transfer at high temperature to permit burial or it may be necessary to get the material away at room temperature so that it will not distort after it leaves the bed. The correct bed, with the required flexibility to meet the demands of the product, is a subject that must be given careful study in designing a mill.

14 IN. MERCHANT MILL COOLING BED (FISK TYPE)

Figure 1 is a photograph of the cooling bed installed on the 18-14 in. merchant mill at Great Lakes Steel Corporation. A duplicate of this has recently been installed on the 18-14-10 in. merchant mill of the Kaiser Company, Inc., and is described in the following.

Both of these beds are 250 ft long from centerline to centerline of end rollers, and the distance from centerline of run-in table to the centerline of the main shear runout table is 18 ft-5 in.

Presented before A. I. S. E. Rolling Mill Committee Meeting, Pittsburgh, Pa., May 14, '45

The bed takes the delivery from No. 14 stand of the merchant mill, the product consisting of:

Rounds	½″ to 2½″ diameter.
Squares	⅞″ to 2″.
Beams and channels	3″ and 4″
Equal angles	1½″ x 1½″, ⅛″ to 5/16″ inclusive, and up to 3″ x 3″, 5/16″ to ½″ inclusive.
Unequal angles	2″ x 1½″, ⅛″ to ⅜″ inclusive; 2½″ x 1½″, 3/16″ x 5/16″ inclusive; 3″ x 2″, 5/16″ to ½″ inclusive; 3″ x 2½″, ¼″ to ½″ inclusive; 3½″ x 2½″, ¼″ to ½″ inclusive.
Square edge and round edge flats	1¼″ to 6″ wide, ⅛″ to 1½″ thick.
Miscellaneous sections	

Leaving the last stand of the 14 in. mill the piece crosses a chute 15 ft long and a 25 ft swivel section of table containing individually driven rollers. This table section is adjustable to line up with any groove in the mill rolls and to deliver the bar in as nearly a straight line as possible to the flying parting and test bar shear, located 43 ft from the centerline of the mill. By means of a manually operated screw the mill end of this section of table can be thrown 6¾ in. on either side of the centerline of the 14 in. stand. The shear is located 58 ft from the first roller of the cooling bed and a stationary table with individually driven rollers carries the piece to the cooling bed run-in table.

The cooling bed run-in table, as well as the cooling

Figure 1 — Cooling bed on 14 in. merchant mill, Great Lakes Steel Corporation.

bed approach tables, are designed to operate at any speed from 500 to 2500 fpm. Each roller is mounted directly on the shaft of the motor.

Figure 2 is a cross section of the cooling bed. The individually driven run-in table rollers are cast iron, flanged at the motor end and located at a 2 degree skew. The skewing action of the rollers makes the piece hug the live flange of the rollers, which just clears the line of the integral side guards of the apron plates.

At three points along the length of the table there are flag switches for starting the operation of the bed, the flags enabling the operator to properly locate the material along the length of the bed. The bed is normally automatic with the master in automatic position, but may also be operated manually. By means of a timer the delay in starting the bed may be selected by the operator.

The kick-off arms and the apron lift are combined and driven from a single drive. The cooling bed run-in table does not stop but when shaft A is rotated, the first part of the rotation lifts the aprons. The continuing rotation of this same shaft brings the kick-off arms around into contact with the bar, which is now clear of the rollers and has already slid to a stop on the cast iron apron plates. When the kick-off arms have moved the bar off the apron plates, the continuing motion of shaft A causes them to disappear and return to their original position beneath the surface of the table rollers as the aprons are lowered to their initial position.

The bars in the meantime slides down the first down slope of the bed and comes to rest against a continuous abutment in the first straightening groove where, by impact, it receives preliminary straightening.

The oscillation of the rocker shaft B will start automatically from the kick-off limit switch when the kick-off cycle is completed. This rocker drive lifts the bar out of the first straightening groove, in which it has come to rest, by raising the plungers which have been at rest just beneath the surface on which the piece has been lying. This same motion depresses a second set of plungers which have previously been at the top of their strokes in the second straightening groove, so that the bar, immediately after dropping down into the second groove for further straightening, is lifted up to the level of the packing portion of the cooling bed.

If operating in pack formation, the operation of the pack-annealing pusher drive is started by the limit switch of the rocker shaft drive as shaft B comes to rest. This pusher drive operates through shaft C on which are mounted pinions which engage pusher bars. These push against the flat, putting it over onto its edge and clamping it between the pusher heads and counterbalanced packing dogs. As bars are added, a pack is built which increases in width, and the dogs are gradually pushed down the slope of the packing bed until the pack is completely formed, when they are automatically pushed below the surface of the packing bed where they remain until it is desired to start a new pack; then the dogs can be pulled back to their original position by means of motor operation of shaft D.

A limit switch automatically reverses the pack-annealing pusher drive, so that after the pushers complete their stroke, which sets a flat upright against the pack, they return to their initial position ready for the next bar.

A decided advantage of packing flats, besides retarded cooling, is that the flats stand on edge and will cool without side camber, while if cooled flat they may go out of shape.

The main bed is of an unusual design in respect to the carryover bars, which are made so as to present either a flat or notched surface. Each carryover bar has one wing which is notched and another which is flat. The change-over from notched bed to flat, or vice versa,

is accomplished by a motor-driven crank motion. This carryover bed can be used to cool material in either spaced or packed formation.

When used in spaced formation, the notches are used and a round, square, flat, or other shape is deposited singly in the first groove and carried across the bed for fast cooling.

When it is desired to slow-cool rounds or squares the flat surface is used. The rounds will roll by gravity down the surface of the packing bed onto the flat bars and the first bar will come to rest. Subsequent bars will roll down and stop against the first and so on until a pack is formed. The bars are carried across the bed with just enough speed so that the following bars can catch up and thereby form a continuous pack.

When it is desired to pack squares, etc., the pack pusher will push each bar down onto the flat bars of the carryover bed and form a continuous pack.

When cooling structural material the notched bars are generally used. If cooling unequal sections, where the material will pull out of the notches due to cooling effect on same, the flat bars can be used to advantage.

To remove the product from the bed, shuffle bars are provided. Figure 3 gives a good view of this portion of the bed as installed at the 12 in. mill in The Lackawanna plant of Bethlehem Steel Company. When the shuffle bar lift is in the down position, bars will assemble on the apron plates alongside of the runout table as shown in the figure. The shuffle bar lift is operated by motor drive with a limit switch which stops the lift in the up or down position. After elevating the shuffle bars the shuffle bar drive is started, which carries the bars over onto the table.

In dot and dash in Figure 2 is shown a future auxiliary runout table which will permit the installation of a second bar shear with gauge and cradles. Such an auxiliary table is in operation in both the No. 1 and No. 2 merchant mills at Great Lakes Steel Corporation.

The double shear installation offers many advantages. In rolling small bars cut to short lengths, it is difficult for one shear to handle the product of a mill. In case of a breakdown with a single shear the entire mill is temporarily out of commission.

With the double shear line on one side of the bed, it is possible to bring both shear lines out of the cooling bed close to the building columns so that available floor space is not broken up as is the case where double shear lines are obtained by means of double beds.

The material is transferred from the main runout table to the auxiliary runout table by a square transfer motion, by means of which the material assembled on the first cooling runout table may be lifted off of this table and transferred to the auxiliary table.

When a double shear line is installed on one side of the cooling bed, the first cold shear is located at a distance slightly greater than half the bed length clear of the bed. The second shear is located beyond the first shear at a sufficient distance so that the cradles clear.

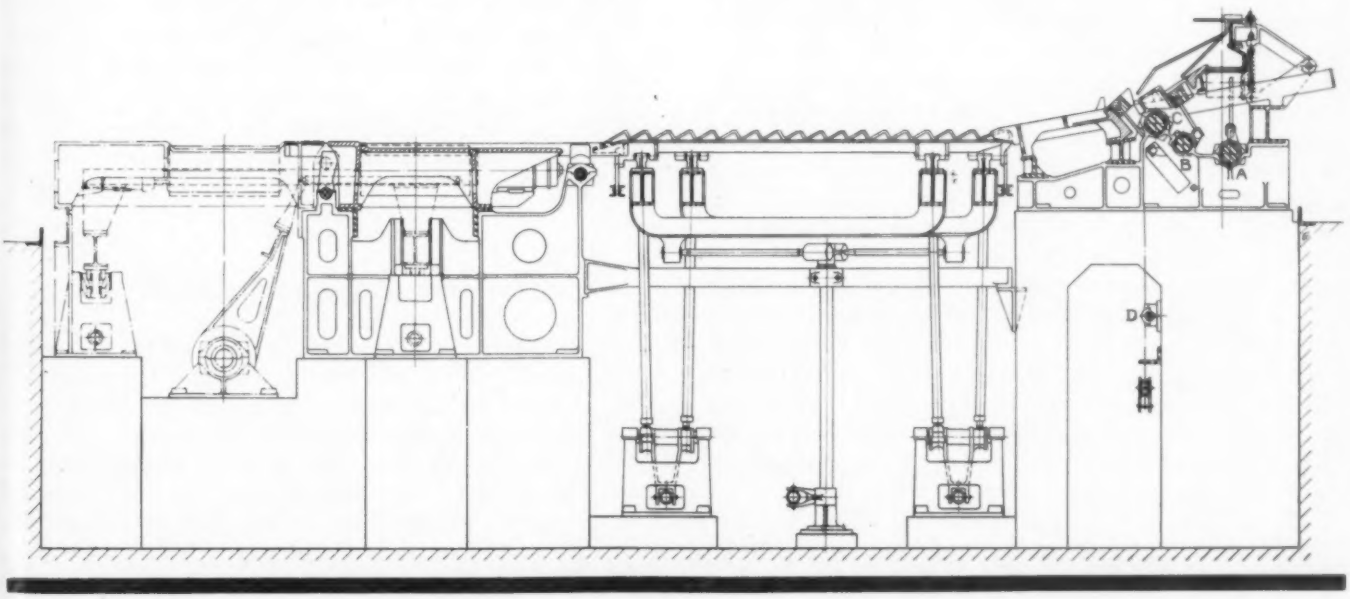
The shearing cycle is as follows: A group of bars are shuffled onto the first runout table, where they are picked up by the square motion and delivered to the auxiliary runout table. While this group of bars is being sheared, another group of bars is collected and is delivered to the main shear. The length of bar which can lie between the cooling bed and the main shear keeps this shear busy long enough after the end of the bars are cleared of the bed to permit the transfer of a set of bars, already collected on the table apron, to the auxiliary shear table and the collection and transfer of another set of bars to the main shear table before the main shear has completed cutting up its first batch.

Figure 4 is a graphic analysis of the cooling bed when cooling in spaced formation in notches. Against the cross-sectional area of the bar in square inches there is plotted:

1. Length of bar on the bed.
2. Net tons per hour mill can roll.
3. Net tons per hour bed will cool.
4. Furnace heating capacity.

Also shown is the size of billet from which the various sections are rolled and the parting necessary to fill the bed. The parting may be done before charging billets

Figure 2 — Section through cooling bed on 14 in. mill outlet of Kaiser merchant mill.



into the furnace, so that two rows of 15 feet long billets are heated, or by the hot billet shear at the delivery door of the furnace, or by the parting and test bar rotary flying shear located in the cooling bed approach table.

The graph shows that when the mill is rolling small bars the output is limited by the rolling capacity of the mill, since the cooling bed can cool and the furnace can heat more than the mill output. As the size of the bars rolled increases, the rolling capacity of the mill and cooling capacity of the bed also increase until the heating capacity of the furnace becomes the limiting factor in the output of the mill. The rolling rate of the mill, the cooling rate of the bed and the heating capacity of the furnace are in balance at about one square inch or 1⅛ in. diameter, which corresponds to what may be termed as an average section for a 14 in. mill outlet.

Flats, when cooled in spaced formation, will cool at the rate of an equivalent round which has a diameter equal to four times the cross section area of the flat divided by its periphery.

When rolling high carbon, high sulphur, high manganese and other alloy steels, which can only be sheared hot and which require burial, the cooling bed is often simply used as a transfer. The bars are walked over as rapidly as possible, sheared, pushed into the cradles and buried at temperatures around 1500 F. Some steels, which do not require burial, shear best at temperatures around 800 F.

When cooling flats in pack formation the cooling rate is independent of the height of the pack, or in other words, the width of the flat which stands on edge in pack formation. This bed can handle steel in pack formation at 70 tons per hour, which is well in excess of the heating capacity of the furnace.

The electrical equipment of the bed consists of motors, control, brakes and limit switches such as are found in any mill. The drives use mill type motors to obtain the many advantages of high torque during acceleration, low armature inertia and rugged construction. The control is of the semi-factory assembled type, built to meet the control standards of the Kaiser mills.

The chief requirement of the control for the bed is speed, that is, the advancing of the control during acceleration must be as fast as possible to meet the fast operation of the bed. For example, the flying bar shear is a start-stop type and has two 50 hp mill frame motors (550/1100 rpm, 230 volts d-c) connected in series. The control has been built so that the motor accelerates to half-speed in ⅛ second, the motor armature making .3 of a turn. The motors accelerate to full shear speed in ⅓ second while the motor armature makes 1.7 total turns. The operation requires a minimum time of 7 seconds between successive cuts.

Another example of control which must be arranged for the maximum accelerating and braking rates is the kick-off drive. The time interval is very short, as one piece must be kicked off the table onto the bed before the next piece arrives. This drive requires that the motor operate at 25 per cent speed during the first quarter of the cycle and at full speed during the remaining three-quarters of the cycle.

The cooling bed approach and run-in table rollers require 68 a-c squirrel cage motors rated at .23/.78 hp, 212/1060 rpm and operate from a motor-alternator set

Figure 3 — Cooling bed on 12 in. mill, Bethlehem Steel Company.

with an output frequency of 11.2/56 cycles per second. Each table roller is overhung on the motor.

The cooling bed runout table has 44 a-c gear motors of squirrel cage type, 900 rpm synchronous speed, 105 rpm shaft speed, which are arranged with individual motor disconnects and overload protection. The control is arranged so that alternate rollers on the table accelerate as one group and the remaining rollers accelerate as another group. Reduced voltage starters are used to keep down the power demand and to provide smoother acceleration. One master switch is used for the control of the 44 motors.

In the cooling bed run-in table each flag for starting the flying bar shear and the cooling bed kick-off consists of a group of three motors (each with an overhung roller) which are insulated from the supporting beams in such a manner that a pilot circuit is completed through the delivered bar from the grounded beam to the three motor frames in parallel and back to the power source. The circuit is at 30 volts potential. Three rollers are used so as to eliminate the possibility of the delivered bar jumping over and failing to complete the circuit. The insulation raises the flag motor rollers about ⅛ inch above the normal top of the runout table. A timing relay on each flag permits the operator to compensate for mill delivery speed to position the material on the bed.

All controls for the bed may be manually operated to check operating features of the mechanical or electrical equipment; however, most of the motions are interlocked through cam limit switches of other drives, so that the operator can make the proper set-up and the bed will then receive and deliver bars automatically.

18 IN. COOLING BED KAISER MERCHANT MILL

This bed shown in cross-section in Figure 5 is located between the 14 in. mill cooling bed and the main cold bar shear. The bed is 125 ft long x 39 ft-8 in. between the centerline of run-in and runout tables. This bed takes the delivery from No. 12 stand of the merchant mill, the product consisting of rounds 2½ in. up to 4½ in. diameter; squares 2 in. to 3 in.; flats up to 6 in. wide and up to 2½ in. thick; and plate girder stock up to 16 in. wide.

The rollers of the run-in table are straight cylindrical cast iron, roller-bearing mounted, spaced at 4 ft intervals, and driven through bevel gears by a 25 hp, 650 rpm, mill type motor at 350 fpm. The table is of the start-and-stop type, with fixed cast iron apron plates. A spring-loaded safety bumper is provided at the end of the run-in table to prevent the piece from running off the end of the table accidentally.

The kick-off consists of sliding carriages, each carrying two disappearing dogs. Carriages are spaced at 2 ft intervals along the full length of the table. The dogs are linked together and appear when the connecting rod which actuates the carriage is pulled as shown in the figure. On the return stroke, the dogs disappear before the carriage starts to move, so that there is no interference with another bar which may be coming down the table before the kick-off has returned to its initial position.

The first stroke of the kick-off delivers the bar clear of the rollers onto the landing table which is installed in this bed to give a flat surface for the initial cooling of plate girder stock — one of the products of this mill. The second stroke of the kick-off delivers the bar to the first carryover section of the bed. The drive is a crank motion controlled by a cam limit switch to provide an accurate stop.

At three points along the length of the table there are flag switches which start the operation of the bed in the same manner as for the 14 in. bed. Each flag is connected to a selector switch which permits the operator to load the bed to best advantage.

The bed has two carryover sections. The first section has bars which are both notched and flat so that the section can present either a notched or flat surface to the material. A 15 hp mill type motor operates the turnover mechanism for changing from a flat to a notched bed or vice-versa.

The second carryover section is provided with flat bars only, except that four pairs of these flat bars, spaced at intervals along the bed, carry hinged notch bars. The notch bars are used only when rounds are being handled, keeping them in alignment. They would otherwise get out of line on a flat bed. When flats are being handled these four pairs are manually turned so that the notch portion is out of sight and rest on supporting lugs projecting from the body of the flat bar.

The two carryover sections are driven by two 75 hp mill type motors, connected in series for half-speed operation. The carryover drive and kick-off are so interlocked that neither may be started while the other is in motion.

The cooled bars are delivered from the flat section of the bed to shuffle bars, and are then delivered to the cooling bed runout table in the same manner as on the 14 in. cooling bed, and over the same runout table to the same shear and cradles.

The bed is also designed to permit the future installation of an auxiliary runout table with carryover as shown in dot-and-dash in Figure 5.

Figure 6 shows this bed as installed in the Kaiser 18-13-10 in. merchant mill at Fontana, California.

The advantages to be derived from a second runout table and cold shear were pointed out in the description of the 14 in. bed. It is to be noted that this cooling bed is short and wide, in order to cool heavy bars, while the 14 in. bed is long and narrow to cool light bars. This makes the plant the same as one having two cooling beds with two shearing lines for each bed, since only one bed is being filled at any one time.

The double shearing line outlet has been installed on a similar bed in the No. 1 merchant mill of the Great Lakes Steel Corporation.

The run-in table has a mill motor on a lineshaft drive instead of individual motor roller drives. The flags for the normal automatic operation of the bed are hatchway limit switches, equipped with a light weight, well-balanced trigger mechanism between rollers, to be operated by the bar as it passes along the run-in table. These flags have been satisfactory on the relatively

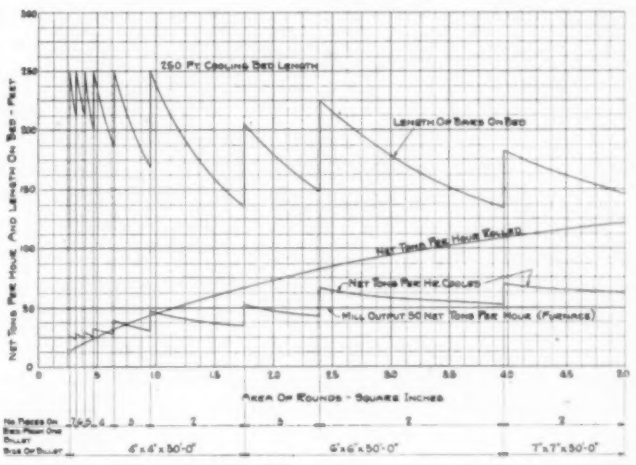

250 Ft. Cooling Bed Length
Length Of Bars On Bed
Net Tons Per Hour Rolled
Net Tons Per Hr. Cooled
Mill Output 90 Net Tons Per Hour (Furnace)
Area Of Rounds - Square Inches
6"x6"x30'-0"
6"x6"x50'-0"
7"x7"x50'-0"

Figure 4 — Analysis of 14 in. mill cooling bed, Kaiser Company, Inc.

▲

Figure 5 — Section through 18 in. mill cooling bed, Kaiser Company, Inc.

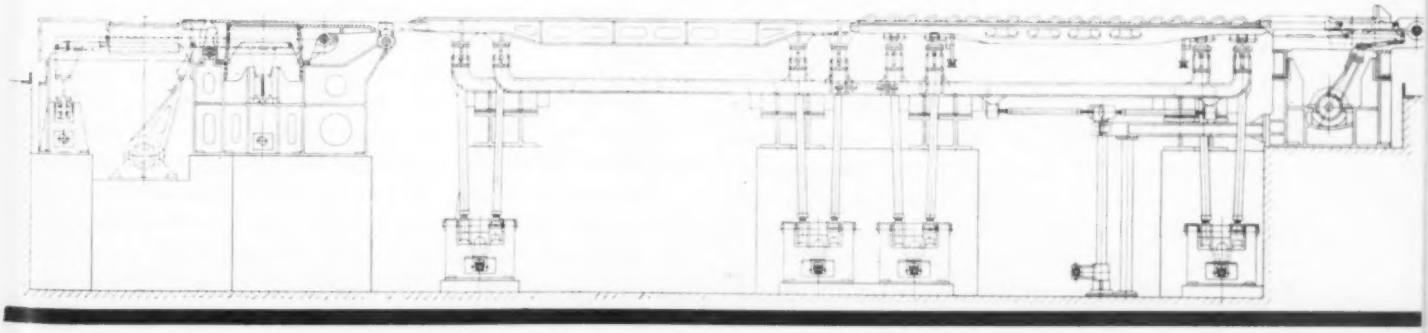


Figure 6 — Cooling bed on 18 in. mill, Kaiser Company, Inc., Fontana, California.

slow 18 in. bed but they are not adequate on a high speed bed like the 14 in. where the insulated roller type of flag is used. As in the case of the 14 in. bed, there are three flags with adjustable timing for spacing the materials on the bed at the selection of the operator.

The electrical control, with its interlocking for the various automatic motions of kick-off, carryover, shuffle bar, etc., is quite similar to that on the 14 in. cooling bed. The operation of the kick-off and other motions must be fast to keep the bed operating continuously. The 25 hp kick-off motor operates at 25 per cent speed during the first quarter of its complete cycle, then at full speed for the remaining part of the cycle which ends in an accurately positioned stop. The low speed at the beginning of the cycle permits the fingers to contact the bar gently without producing surface marks on the bar, a condition which may occur with the fingers starting at high speed.

Each drive is arranged for full automatic operation while the master switch is on automatic but is also designed for manual control of the bed to permit checking and adjusting mechanical or electrical equipment, and to clear the bed.

Figure 7 is a graphical analysis of this cooling bed. Curves are plotted for rounds. For other sections, the rule to convert from any given section to an equivalent round for cooling purposes has already been given. Here, as in Figure 4, against the cross-sectional area of the bar in square inches there is plotted:

1. Length of bar on the bed.
2. Net tons per hour mill can roll.
3. Net tons per hour bed will cool.
4. Furnace heating capacity.

The size of the billets from which the various sections are rolled and the parting necessary to fill the bed to best advantage are also shown. It will be noted that not more than two partings are ever necessary, and then only for a very narrow range of products. This parting can be done at the hot billet shear on the delivery end of the furnace, or, when single parting is required, by charging two rows of 15 ft billets into the furnace.

It is evident from the curves that the limiting factor in the production rate of this mill, as far as this bed is concerned, is the capacity of the furnace. For an average section of 10 square inches, the cooling bed can cool at a rate of approximately 100 net tons per hour, and the mill can roll at a much higher rate. Therefore, if the mill were primarily designed to roll large sections, additional furnace capacity would have to be provided.

10 IN. MERCHANT MILL COOLING BED

This Fisk type cooling bed is installed in the No. 2 merchant mill of the Great Lakes Steel Corporation. It is 255 feet long from centerline to centerline of end rollers of the run-in table by 16 ft-4 in. between the centerline of run-in and main runout table. Figure 8 is a cross-section of the cooling bed which has 20 notches spaced on 5 in. centers. This bed cools the entire output of the mill, which consists of rounds from $\frac{3}{8}$ in. to $1\frac{1}{8}$ in. and equivalent squares, flats from 1 in. to 4 in. wide up to $\frac{1}{2}$ in. thick, and other miscellaneous sections.

The bars, as they come from the mill, are stopped by lifting table aprons, are kicked-off down a steep terrace drop along side of the table, and come to rest against the packing section of the cooling bed, which gives the preliminary straightening by impact. This 10 in. bed differs from the 14 in. cooling bed already described in that the 10 in. bed has only one steep terrace, ahead of the packing bed, whereas the 14 in. cooling bed has two. The double terrace is advantageous when beams or channels are being rolled in the mill. When the mill is designed primarily to roll rounds, squares and flats, it has been found that the single abutment gives satisfactory results.

32 IN. BAR MILL COOLING BEDS

The two cooling beds shown in Figure 9 serve the delivery of a three-stand 32 in. two-high bar mill rolling 3 in. to 10 in. rounds and equivalent squares of carbon and alloy steels.

When the bar leaves the finished stand, it is delivered on a runout table from which it can be transferred to either of two saw approach tables. After the bar has been sawed to gauge length and stamped, they can be transferred from either side back onto a central table which runs through to the two cooling beds.

Two movable stops are mounted on the run-in table directly opposite each bed. These stops are of the gate type, spring-mounted and equipped with roller bearings, and are easily moved in a track mounted along the table. The stops need only be moved short distances in order to accommodate the various lengths of bars delivered to the cooling beds.

Each cooling bed is 80 ft wide from centerline of run-in to centerline of runout by 39 ft long outside to outside of fish plates. Each bed is of the rope type and has six drag-on carriages and six drag-off carriages. The carriages are equipped with disappearing dogs.

The drag-off carriages have the dogs mounted on the extreme front end so as to push the bars from the cooling and completely onto the runout table. The drag-on carriages have the dogs mounted on the rear of the carriages so that they need not travel any further than necessary to engage the material on the run-in table.

Referring to Figure 10, the carriages have ropes fastened at each end; the other end of each of the two ropes of each loop is fastened to the drum. This method

of reeving makes the drive positive and not dependent on a friction grip of the rope on the drum. Weight-balanced take-ups are provided to keep the ropes in tension on the top side when running in the reverse direction. To correct for minor misalignment of the dogs, the drums are provided with a manually operated worm and wheel adjustment. After being correctly aligned, uneven stretch in the ropes is the only cause of future misalignment and this is corrected by realigning as explained.

The drag-on and drag-off of each bed are driven separately by a 75 hp mill type motor through a double reduction spur gear drive. The rope speed is 300 fpm. Dynamic braking, brakes, and limit switches to prevent overrunning the ends of the travel and to permit accurate maneuvering of the material when forming or opening a pack are provided.

As shown in Figure 11, the bed is covered with thick cast iron fish plates of short lengths with sufficient clearance between the joints so that expansion will not jam them endwise. Since the fish plates contact the supporting beams on only a small portion of the flange, the beams will not heat excessively and therefore will not warp badly.

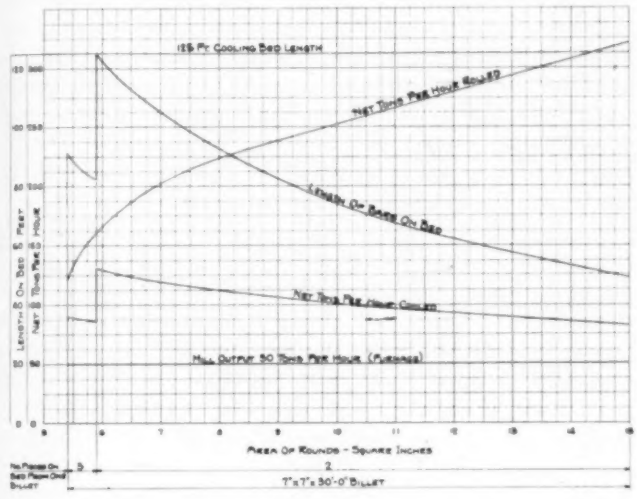
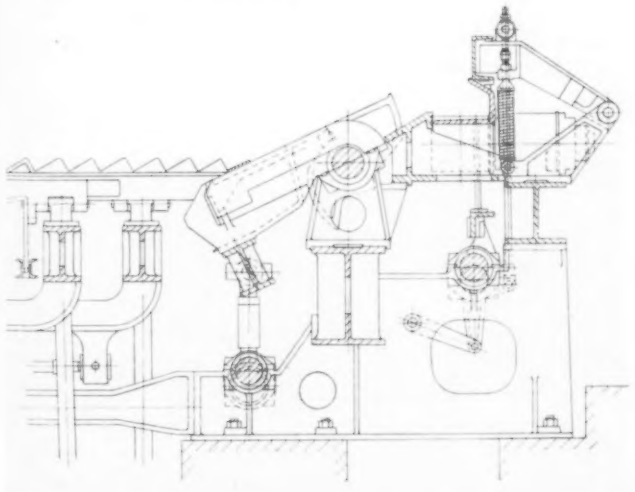

125 Ft. Cooling Bed Length
Net Tons Per Hour Rolled
Mill Output 90 Tons Per Hour (Furnace)
Area Of Rounds - Square Inches
7"x7"x 30'-0" Billet

Figure 7 — Analysis of 18 in. mill cooling bed, Kaiser Company, Inc.

▲

Figure 8 — Cross-section through 10 in. mill cooling bed, Great Lakes Steel Corporation.



The bed is designed so that it can be filled with full length, one-half length, and one-third length bars. When filling with full length bars, the proper method would be to fill up one bed and unload the other bed simultaneously. The drag-on dogs would pull two or three bars clear of the run-in table and then transfer these bars as a unit to just clear the runout table. Handling rounds in groups keeps them from rolling. This operation is repeated until the bed is packed full, the bars being tight against each other. When the beds are filled in halves or in thirds the operator would load first the four halves or six thirds; subsequently, he would unload them in the same sequence.

To permit this flexibility of operation hydraulic selector switches have been provided on two pulpits, one of which is located near the drag-on side of the bed and the other near the drag-off side. The location of these pulpits, close to the tables, allows the operators clear visibility over the beds.

The operator on the drag-on table can depress all of the drag-on dogs by running the drag-on carriages back farther than their normal stop position until a lever mounted on a shaft extending through each carriage engages a spring-cushioned stop. The rotation of this shaft causes a finger to tilt the carriage dog into the depressed position where it remains. The carriages can now all be advanced underneath the material on the bed. Over toward the runout side of the bed there are other stops which can be engaged and which will cause the dogs to reappear. These stops (see Figure 12) can be operated from the pulpit so that the selected dogs may be made to appear while the others remain depressed. The same selector system is available for the drag-off dogs. Thus the operators can be loading part of the bed while unloading another part of it without the necessity of a man walking out on the bed to block up dogs.

From observations made on this and similar beds, it appears that the cooling capacity of such a bed operated in pack formation is like the heating capacity of a furnace in that it is dependent on the area loaded and not on the thickness of the billets. If the thickness is doubled, the tons which can lie on a given area is doubled, and while the amount of heat to be dissipated is doubled, the time to do it per ton is also doubled so that the tons per hour for a bed covered with billets or slabs is a fixed quantity if the material is brought on and removed at the same temperature. A study of the capacity of these beds shows that they will each handle 100 tons per hour if completely covered. This mill is rolling about 120 tons per hour and the best record to date is 200 tons per hour.

It has been observed that when the bed was full of 6 in. square billets the top of the material was black while the surface in contact with the fish plates still showed a red color. This indicates that heat is being dissipated at a much higher rate from the top of the pack than from the bottom of the pack. This is logical since air cannot circulate through the material on the bed.

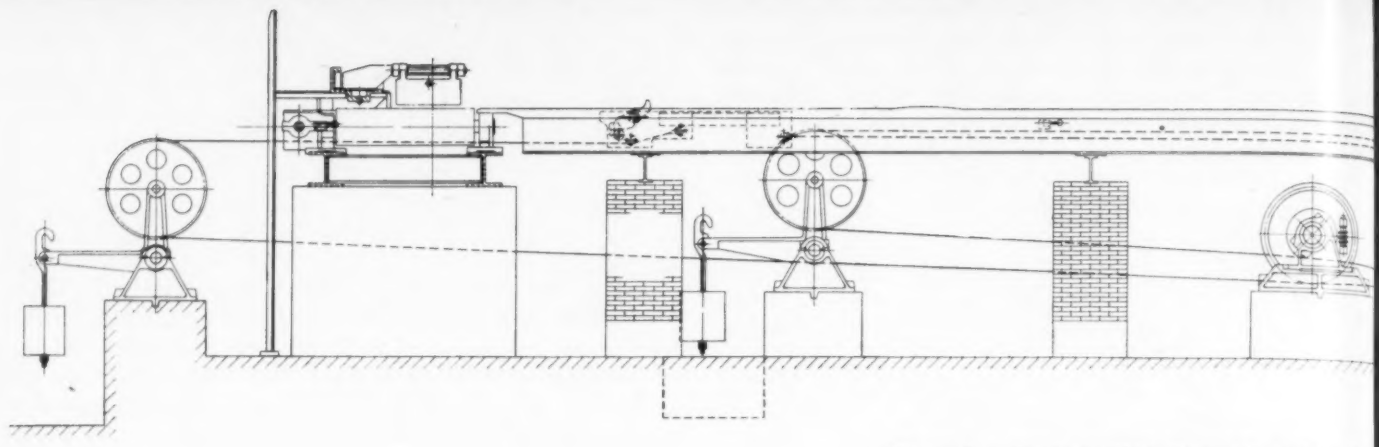


Figure 9 — Cross-section through cooling bed on 32 in

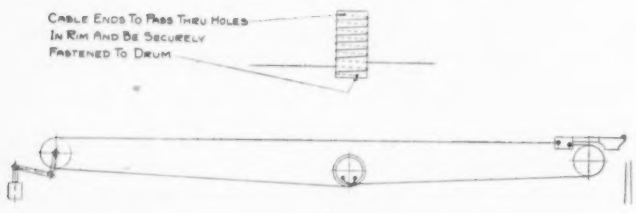


Figure 10 — Method of reeving ropes on cooling beds on 32 in. bar mill in the Chicago district.

When the bars leave the cooling bed, they are delivered by the runout table against either of two stops, and are then pushed off onto a piler. One stop is of the stationary spring-loaded type, located at the end of the table; the other stop, of the disappearing type and motor driven, is used when piling half-length and third-length bars. The pushers are of the double rack-and-pinion type, motor driven. The piler is of the elevating type. Both the pushers and pilers may be operated as a unit or in halves by engaging or disengaging clutches provided for this purpose.

32 IN. BAR MILL HOT TRANSFER AND PILER

The 32 in. three-stand mill is required to roll a large tonnage of high alloy steels which must be sawed to length, as they will not stand cold shearing. Since these high alloy bars must be buried in pits so as to cool slowly, a fast transfer has been provided to get the material to the burial pits quickly.

The material, after being sawed and stamped, engages either of two motor-driven disappearing stops located in the hot transfer run-in table, and is then pushed clear of the table onto the transfer.

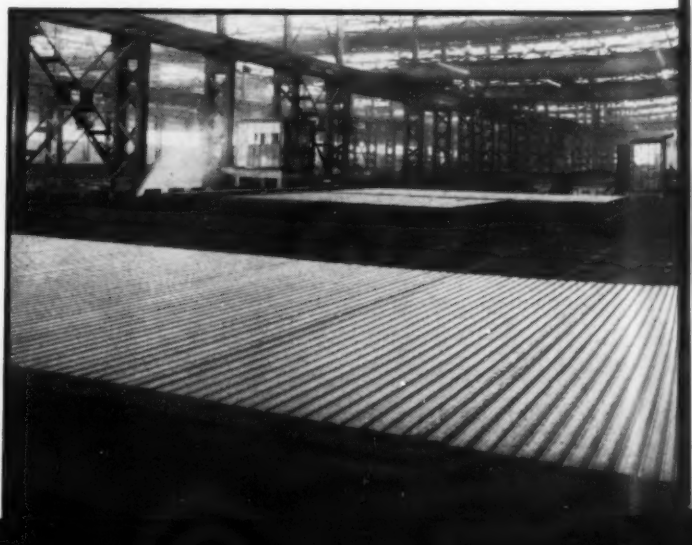
The transfer is 35 ft-3 in. wide from centerline of run-in table to centerline of piler. The length is 35 ft-4 in. between the outsides of supporting beams. These beams are cast iron and are not provided with fish plates since it is not intended to use this transfer as a cooling bed; consequently, hot material will not lie on it in close pack formation.

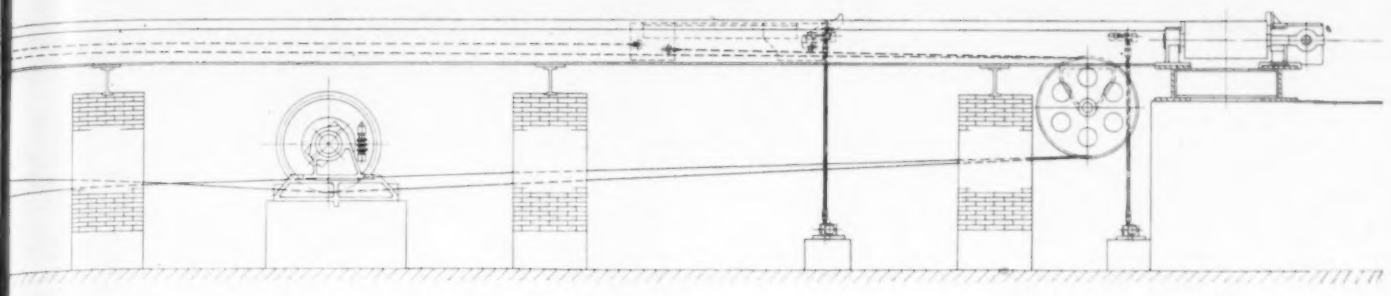
The transfer, shown in Figure 13, is of the reciprocating dog type and is driven by two 50 hp mill type motors through worm reducers and crank motions. When in use, the transfer runs continuously at a speed of 9 rpm, and since the dogs have a 3 ft stroke, the material crosses the transfer in just over one minute. Within three minutes after leaving the mill, material to be buried will be in the piler at a temperature of 1500-1600 F, and once the bars are piled the temperature drop is very slow, so that the pile can be removed and put in the burial pits with little additional temperature drop.

Since the product which requires hot burial may be cut to short lengths, the transfer, pusher and piler were designed to fulfill these requirements. Clutch mechanisms have therefore been provided so that the two pushers, the two halves of the transfer and the two halves of the pilers can each be operated as one full width unit or in halves by shifting the clutches.

If the bar does not land true as it drops into the piler and cradles, it is straightened and properly located by means of manipulator fingers which can be moved across the cradles or pulled back entirely under the

Figure 11 — Two cooling beds on a 32 in. bar mill in the Chicago district.





cooling be on 32 in. bar mill in the Chicago district.

table. By the use of these fingers and raising or lowering the cradles as desired, it is possible for the operator to make a perfect pile. This is very important, especially in handling hot material. If the pile is not perfect, the hot bars (especially small bars) may be deformed by the material on top of them and it will be necessary later to do a lot of straightening.

As shown in Figure 14, after the pile has been made, it is lowered onto another set of cradles which extend down and are mounted on the scale platform. This scale platform extends over the full length of the piler, and if the piler is being operated in halves, then one half-length pile can be lowered onto the scale and be weighed while another half-length pile is being formed on the cradles in the adjacent half of the piler.

The pushers are each driven by 35 hp mill type motor with stroke fixed by limit switches.

In all cases where shifting clutches are supplied to permit individual or duplex operation, a track type limit switch is operated by the manual clutch-shifting lever to control the changeover from individual to duplex operation, or vice-versa.

COOLING BED IN 16-14-12 IN. CONTINUOUS SKELP MILL

The cooling bed shown in Figure 15 serves the outlet of a 16-14-12 in. continuous skelp mill which produces skelp in widths ranging from $2\frac{11}{16}$ in. to $15\frac{1}{8}$ in. wide in thicknesses from .102 in. to .500 in.

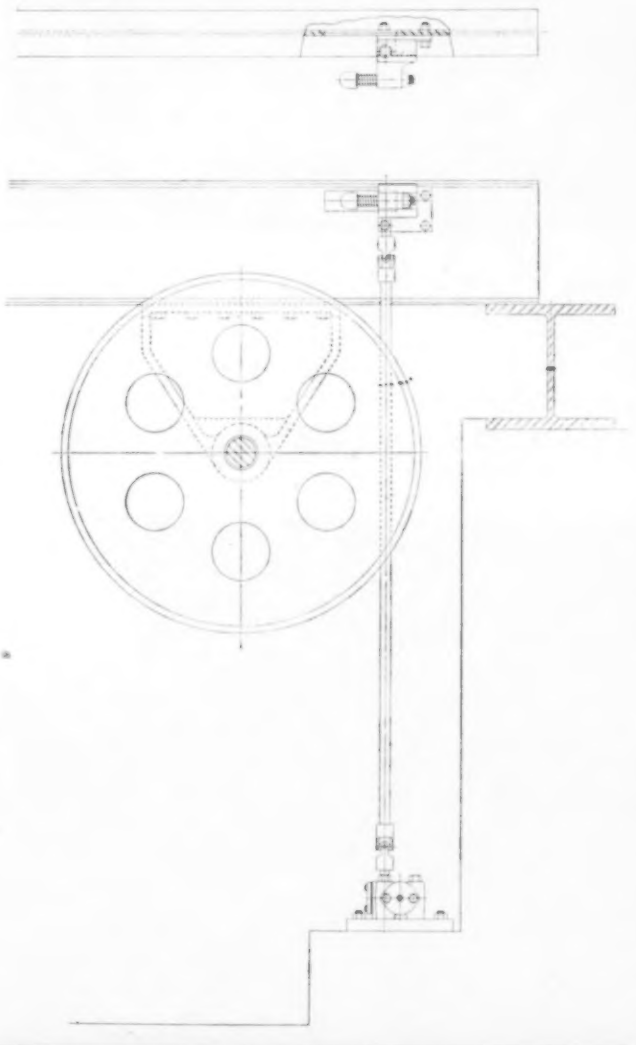
The skelp, as it is delivered from the finishing stand, passes through a rotary flying shear where it is cut into skelp lengths of 20 ft-6 in. As the skelp approaches the cooling bed, it is sprayed with water so that thin skelp reaches the bed at a temperature of 1000-1100 F.

The cooling bed is 50 ft wide from centerline of run-in table to centerline of runout table. The length is 22 ft-4 in. out to out of supporting beams. Cast iron beams without fish plates support the product. Dogs are spaced at 17 in. and have a stroke of 20 in. The general design of the cooling bed is similar to the hot transfer already described.

The skelp is shingled as it leaves the shear and comes to rest against a spring-loaded stop. The pile is then pushed off the run-in table onto the bed by a pusher, motor-driven through a crank motion.

The skelp leaves the bed at a temperature of approxi-

Figure 12 — Sketch showing selector stops on 32 in. mill cooling bed.



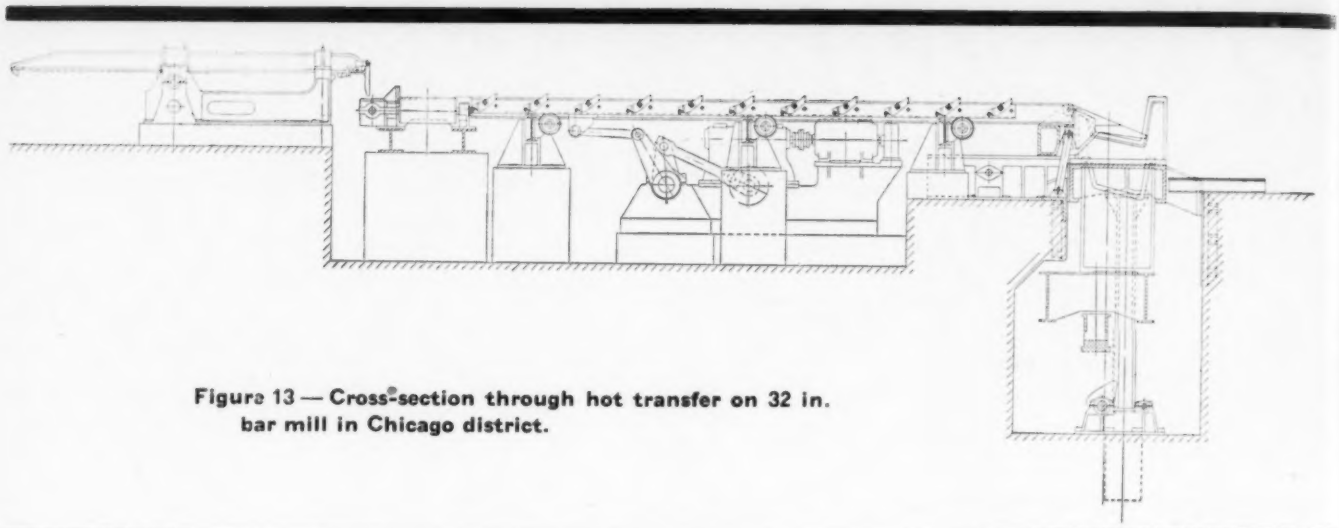


Figure 13 — Cross-section through hot transfer on 32 in. bar mill in Chicago district.

Figure 14 — Hot transfer and piler on 32 in. bar mill in the Chicago district.

▲

Figure 15 — Cooling bed on 12 in. skelp mill, Wheeling Steel Corporation.

mately 650 F and is then conveyed by the cooling bed runout table to piling cradles located on each side of the table.

The cradles are of the stationary type mounted on scale platforms. The kick-off pushes skelp onto the cradles on one side of the table and then on the other side, alternately.

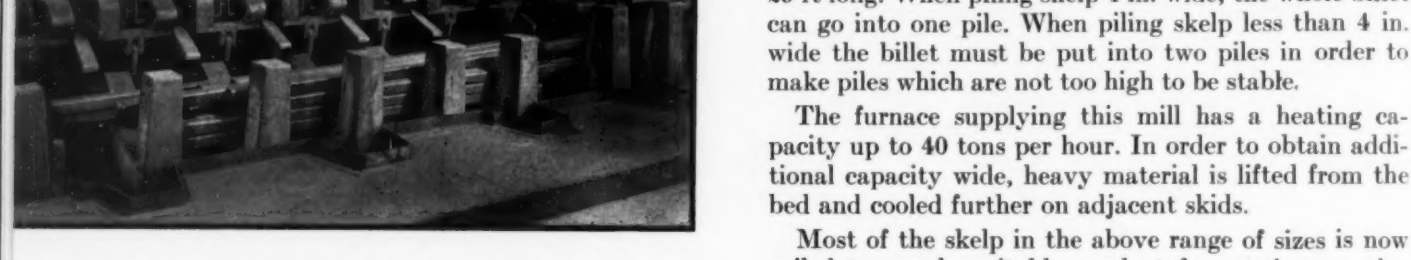
Skelp up to 4 in. wide is rolled from 3 in. x 4 in. billets 29 ft long. When piling skelp 4 in. wide, the whole billet can go into one pile. When piling skelp less than 4 in. wide the billet must be put into two piles in order to make piles which are not too high to be stable.

The furnace supplying this mill has a heating capacity up to 40 tons per hour. In order to obtain additional capacity wide, heavy material is lifted from the bed and cooled further on adjacent skids.

Most of the skelp in the above range of sizes is now coiled to supply suitable product for continuous pipe mills.

28 IN. STRUCTURAL MILL COOLING BED

Figure 16 is a picture of the cooling bed installed at



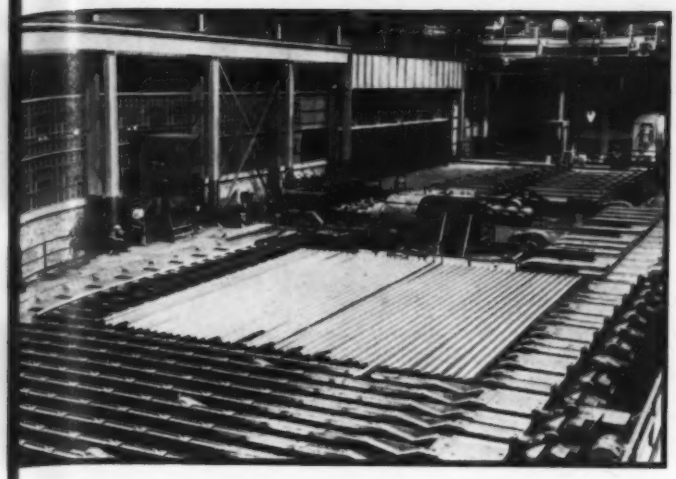


Figure 16 — Cooling bed on 28 in. structural mill, Kaiser Company, Inc.

the 28 in. three-high structural mill at Kaiser Company, Inc. The bed is 50 ft wide from centerline of run-in table to centerline of runout table by 68 ft-3 in. long out to out of fish plates. It is designed for cooling the following sections:

American standard beams	5″ x 3″ up to 20″ x 7″.
H-beams	6″ x 6″ and 8″ x 8″.
Equal angles	3½″ x 3½″, ¼″ to ⅝″, up to 8″ x 8″, ½″ to 1⅛″.
Unequal angles	4″ x 3″, ¼″ to ⅝″, up to 8″ x 6″, ½″ to 1″.
Bulb angles	6″ x 3½″, 10.7 lb to 17.4 lb up to 10″ x 3½″, 22.4 lb to 32.3 lb.
American standard channels	5″ x 1¾″ to 18″ x 4″.
Shipbuilding channels	10″ x 4″ to 13″ x 4″.

The bed is equipped with a combination drag-on and setting-up device, an intermediate transfer, and a drag-off transfer. A V-notch across the full length of the bed is provided which, in conjunction with the roller bearing equipped fingers on the drag-on channel, causes I-beams and channels to be set up on their flanges as they emerge from this trough. In the event that it is not desired to set the material up, the V-notch is spanned by the use of flat bar. These bars, when not in use, hang vertically below the surface of the bed from pins through their top ends. They can be swung up and over to span the trough. These bars in use can be seen in the figure.

When cooling structural sections, material must be allowed to cool to temperatures of 150-200 F, since the material is straightened immediately after it leaves the cooling bed. Material straightened at temperatures higher than 300 F will warp out of shape when cooling to room temperature. When handling round and square bars, the material can be taken off the cooling bed at temperatures of 600 F or 700 F, or even higher if desired. Since the cooling time increases rapidly as the temperature differential between the product and the surrounding atmosphere decreases, a larger bed is required to cool structural sections than is needed for cooling an equal tonnage of squares or round bars.

Below is given the observed time required to cool various sections from mill finishing temperature to 150-200 F:

L-beam	10″ x 25.4 lb	1 hr-15 min
	12″ x 31.8 lb	1 hr-40 min
Channels	8″	0 hr-45 min
	10″ x 30 lb	1 hr-45 min
	10″ x 35 lb	1 hr-45 min
	12″ x 31.8 lb	1 hr-40 min
	15″ x 50 lb	2 hr- 0 min

It is hoped that this data will be of value in future design and that it will be followed by publication of other data which will help in clarifying the problems involved.

DISCUSSION

PRESENTED BY

J. L. McHUGH, Superintendent No. 18 Bar Mill, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania

C. L. RAISIG, Mechanical Engineer, Mesta Machine Company, Pittsburgh, Pennsylvania

J. B. MITCHELL, Superintendent, Rolling Mills Department, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania

J. L. McHugh: What is the best method of keeping bars straight which are much thicker in one part of the section than in another, so that they have a tendency to warp in cooling?

C. L. Raisig: Sections which will not cool straight are given special handling. I-beams are placed on their flanges and laid down at the proper time to produce as straight a product as possible. Rails are cambered before going on the bed to give a product which is as straight as possible when finally cooled. In the paper it was pointed out how these beds could be used as either notched or flat beds. In cooling unequal sections where the material will pull out of the notches the flat bars can be used to advantage. In both the No. 1 merchant mill at Great Lakes and the 14 in. merchant mill at Kaiser, structural shapes are handled and a roller straightener has been provided in the runout table beyond the bed.

J. B. Mitchell: My experience with unbalanced sections has been that, in spite of any hot bed cooling, they will draw out of shape, and must be put through a suitable straightening process to place them within commercial tolerance.

I-beams and similar sections can be held reasonably flat by placing on edge. However, channels, angles, special sections having a non-uniform cross-section will draw in cooling, in spite of anything that can be done on hot bed.

QUALITY CONTROL TESTING OF

Semi-Finished Bars

. . . . through the application of statistical methods in an investigation of steel quality, a control program was set up through which bar surface conditioning was greatly reduced . . . . defective product was meanwhile reduced 40 per cent under previous normals . . . .

by E. W. Mahaney and D. W. Lloyd

YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

▲ WITH ever-tightening requirements for steel quality, the subject of quality control becomes more and more important in steel manufacture. Such control can do much to improve quality, as is evidenced by the following discussion of a particular problem in surface quality of semi-finished bars.

In order to present the problem more clearly, the process flow sheet (Figure 1) shows the progressive steps by which the semi-finished billets are manufactured and prepared for the finishing mill. The heat size from the open hearth is approximately 130 tons, and about 25 ingots are poured from each heat. The ingots are rolled into 8 in. x 10 in. blooms, with a resultant 50 blooms per heat. These blooms are conditioned by torch scarfing, skinning all four sides of each bloom. The blooms are then charged into a reheating furnace in preparation for rolling to semi-finished size on a cross country bar mill. Five different sizes, each of which contains many grades of steel, are required from the bar mill in order to satisfy the varied types of orders rolled in the finishing mill. Depending upon size and length ordered, there are from 300 to 800 billets comprising one heat. These bars, until the changes brought about through this investigation, were practically all pickled and conditioned before reheating for the finishing mill.

The surface quality of the product of the bar mill had for years been judged mainly by the final inspection results of the finishing mill. Fluctuations in the percentage of defective material on the finishing mill had been wide on a day-to-day basis, and still more extreme on a heat-to-heat basis. However, toward the latter part of 1943 and as a probable result of increased tempo of operations and ever-increasing manpower shortages leading to unskilled replacements, these quality fluctuations became much more pronounced. Management asked that a thorough investigation be made of all factors which might possibly improve the product and that, if at all feasible, action be taken to effect that improvement.

Presented before A. I. S. E. Rolling Mill Committee Meeting, Pittsburgh, Pa., May 14,'45

METHOD OF ATTACK

The investigation was begun by asking that the mill cut a test 6 in. long from the billet product of every second bloom. This yielded approximately 25 tests per heat of steel rolled, and furnished a fairly uniform cross section of each heat. These tests were delivered to the metallurgical laboratory, where they were sawed, pickled and critically inspected for all surface defects. A very careful and detailed log was maintained, listing the number of defects found, an actual measurement of the severity or depth of the defects, and a description of the physical appearance of the defects.

During the inspection, grading and logging of these test results, it was soon apparent that much improvement could be hoped for. It was also noted that several different types of defects were present and that their

respective causes were probably varied. Thorough microscopic examination of many typical specimens served to classify the majority of the defects. Through the aid of the open hearth observation corps and a camera installation in the blooming mill, and through examination and experimentation with roll designs in the bar mill, some possible improvement was indicated. Consequently, several of the standard open hearth practices were changed and a rigorous quality campaign was commenced. Bloom conditioning practices were tightened and several important changes in bar mill roll design were effected. These changes were immediately reflected in the finishing mill inspection results. The amount of defective material produced had been drastically cut.

STATISTICAL METHODS INTRODUCED

It is beyond the scope of this paper to present a discussion on the theoretical aspects of the statistical methods used in the further development of the initial problem. We shall, however, outline briefly the steps and procedures used.

The improvements gained through the changes in practices and through greater vigilance in all departments was, of course, quite evident in the results of the 25 heat lot tests still being made. It was noticed that many heats were now showing not even a single defect out of the 25 tests, while many other heats showed the presence of only one or two defects of very minor depth. It seemed sensible then that these assumd "good" heats of semi-finished billets might not require the expensive time-consuming conditioning process. With extreme caution some of these full heats, or in many cases half heats, were sent directly to the finishing mill with no pre-conditioning. The finished material was carefully watched and after a several month experimental period, during which time much tabulation and statistical examination of the data were made, the following conclusions were drawn:

1. Much of the semi-finished material did not require conditioning for good performance in the finishing mill.
2. The 25 heat-lot tests were a good criteria for judging the quality of a heat between certain limits and at certain degrees of probability.

In elaboration of this second point, we should turn briefly to a crude schematic description of the theory behind the significance of tests.

Figure 2 shows something of the accuracy of a prediction of lot quality as judged by the results of a given number of tests or samples. It should be noted that, as the number of samples inspected is increased, the accuracy of the prediction increases. When 100 per cent of the lot is tested, the prediction of course is perfect. In introducing the word "probability," it must here suffice to say that if one is willing to chance being wrong in his predictions once in ten times (0.90 probability), the band of prediction is much narrower than if he must be right in 95 out of every 100 predictions (.95 probability). With this reasoning and with proper statistical technique, any number of these converging bands could be drawn representing varying degrees of probability. Figure 2 should be taken only as a crude representation of the picture, since in actuality the lines are curvilinear and not necessarily symetrical as shown. Much statistical theory lies in the construction of accurate curves.

Mention has been made that many of the heats taken from the billets revealed defects of minor severity. Through a correlation of finishing mill performance against actual bar defect depths (measured with a small calibrated microscope), it was relatively simple to determine what severity of defect should be considered critical. These critical depths of defect were determined on all sizes and grades of billets.

At this point, sufficient data and working knowledge were at hand to set up a formal acceptance sampling plan which, when properly designed, could send a certain percentage of heats direct to the finishing mill with no conditioning. The plan could be designed to furnish protection at certain economic levels of probability so that any direct heat would contain no more than a certain acceptable percentage of defective material. The plan would send those heats whose tests indicated poorer quality to the conditioning yards for cleaning.

To arrive at an acceptable level of defective material, the long-time averages of each size and grade were de-

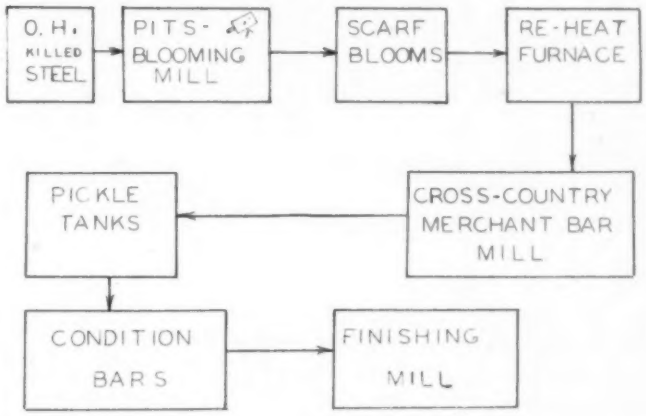


Figure 1 — Process flow sheet previous to start of investigation.

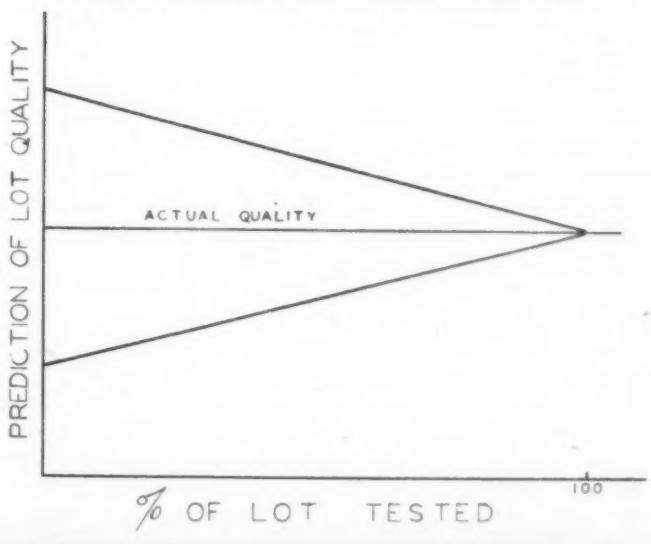


Figure 2 — The accuracy of prediction of lot quality increases with the number of samples inspected.

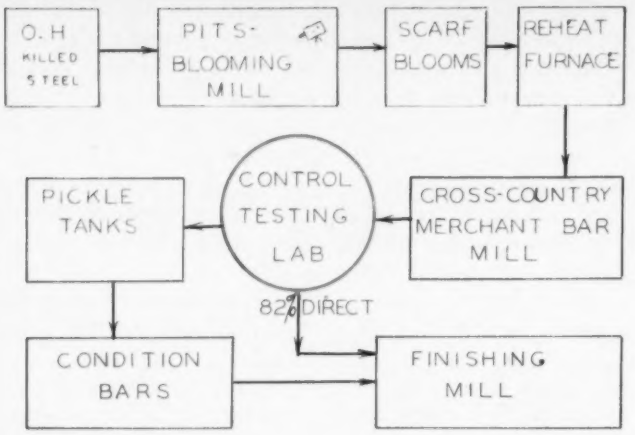
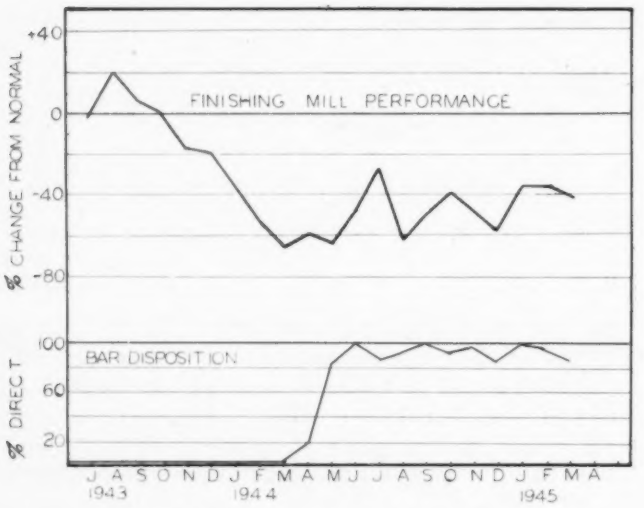


Figure 3 — Process flow sheet as revised by control testing program.

▲

Figure 4 — Overall results of investigation and of changes it occasioned show bar conditioning vastly reduced and a marked decrease in defective product from the finishing mill.



termined. This average was named the "squawk level." The sampling plan was so designed as to protect against having direct heats exceed the "squawk level" of defective material in more than once out of ten times (.90 probability). This might be considered the upper line in Figure 2. The chances of having the tenth heat exceed this level by any great amount are low. The acceptance table, then, in simple terms, allows a heat with a certain number or less of critical defects in a given number of tests to go direct without conditioning. Heats with more than this certain number of defects must be pickled and conditioned.

RESULTS

A small laboratory has now been constructed in the bar mill, so that the disposition of a heat is known before the heat is loaded into cars. Figure 3 shows the process flow sheet revised to include the control testing program and its functions. Over a period of a year, 82 per cent of the product of the bar mill tested was sent direct. This represents thousands of tons of billets and has resulted in savings of the two most critical components, steel and manpower.

Figure 4 shows the results of the overall investigation and its subsequent action in terms of the quality changes effected on the product of the finishing mill. It appears that the amount of defective material produced has been reduced approximately 40 per cent below the normal established during 1943.

We should mention finally something of the maintenance of this improved quality level. The control testing operation acts as its own supervisor, since its results in percentage of defective material and percentage of product sent direct, are entirely dependent upon the quality of workmanship and material preceding the sampling. At regular intervals, typical defective tests are checked microscopically and their source of defect assigned. The responsible department is then most willing to find and correct the trouble. The result has been a much improved product with much greater uniformity in overall quality performance.

DISCUSSION

PRESENTED BY

R. C. DIEHL, Metallurgical Engineer, Wheeling Steel Corporation, Steubenville, Ohio

E. W. MAHANEY, Metallurgist, The Youngstown Sheet and Tube Company, Youngstown, Ohio

R. C. Diehl: Mr. Mahaney's report is an excellent example of the results that are possible by combining a sound knowledge of steel mill metallurgy with some rather simple statistical procedures. These results would have been either impossible or at least very much slower if based on either metallurgy or statistics unaided by the other.

One common reaction to a brief introduction to statistics is to remark, "This seems to be a nice method for certain problems, but it doesn't apply to my situation." This statement could very well have been made by Mr. Mahaney, because there were no specific instructions for the procedure he describes in this paper. Instead of taking this attitude, however, he realized that there were statistical relationships involved in one of his important problems and set out to devise a method of solution.

Good data are an important foundation of any study. Unless the original observations are reliable, no amount of statistical treatment will develop any reliable conclusions or lead to effective action.

Some experiences with semi-finished or in-process inspection are disappointing. For example, it was once decided that certain coils would not be applied on exacting orders. The time came when there was such an accumulation of rejected coils that something had to be done. They were rolled on one release and proved to be as good as coils that were not rejected. Mr. Mahaney

(*Please turn to page 63*)

Roll Manufacture AND Application

. . . . describing the types of rolls in common use in American rolling mill practice, together with a brief discussion of the methods of their manufacture and of conditions which influence their application . . . .

by A. E. Murton

CONTINENTAL FOUNDRY AND MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

▲ THERE has been a great deal of progress in the manufacture of rolls for the rolling of steel. In the past fifteen or twenty years the development of the strip mill, and the demands of steel users for new shapes and finer finishes have forced the manufacturers of rolling mill rolls to make rapid progress and changes in the art of roll making.

The rolls used in working and shaping steel and nonferrous metals are the heart of any rolling mill, and the quality of the product finished on any mill varies directly with the quality of the rolls used to finish the metal.

To make a clear picture, it is advisable first to classify mill rolls primarily from the standpoint of the material from which they are manufactured, and secondly, from the standpoint of the use to which they are to be put.

There are two broad classifications of rolls, having as their basis of classification the material of which the rolls are made. They are steel rolls and iron rolls. In the classification of steel rolls there are again two types — regular carbon steel and alloy steels. In the classification of iron rolls there are chilled iron, alloy chilled iron and grain rolls.

Without any doubt, iron rolls will finish rolled steel better than either carbon steel or alloy steel rolls; hence, we think generally of using iron rolls in the rolling operation as many passes before the finishing pass as is consistent with local mill conditions. However, due to the many varying demands of customers which make for extremely critical roll design, it is frequently impossible to use the relatively weak iron rolls in any pass before the finisher, and in some cases, it is impossible to work iron rolls into the necessary series of passes required to make a given section. Therefore, it is well to remember that, in spite of the fact that we always apply iron rolls as early in a series of passes as possible, in many cases heavy work in every pass makes it necessary to use alloy steel rolls even in the final rolling operation.

Strength of rolls is a greatly misunderstood subject. Tensile strength of roll material can be greatly overemphasized. The features we look for are ductility and shear resistance combined to the best possible advantage with resistance to abrasion or wear, and in many cases both shear and ductility are sacrificed to obtain better wear resistance. Ductility and shear can be neglected in larger mills because of the mass effect of the roll itself. The particular point I want to make is that some of our roll materials have high tensile strength, but the same materials are not useable in applications where breakage is a factor because the high tensile strength material frequently has poor properties in shear and ductility. All rolls produced are compromised to meet as many as three or four characteristics which are necessary in a particular application. It becomes the obligation of the roll maker to study each local mill condition in conjunction with the roll designer and mill operators, so that the proper compromise of character-

Presented before A. I. S. E. Rolling Mill Committee Meeting, Pittsburgh, Pa., May 14,'45

istics can be obtained which will give sufficient ductility and shear resistance to do the job, as well as the maximum amount of wear resistance.

Steel and alloy steel rolls are made in a vertical position in sand molds. The flask which is used as a container for the mold itself is made in two halves. The contour of the roll to be cast is made from a sweep mounted on a spindle and revolved in the half-flask to make the half-mold.

The metal enters the mold at the bottom end through a sprue gate set at a tangent to the lower roll neck. The tangential setting of this gate makes the metal enter the mold with a swirling action. This swirling is desirable because it forces the heavier metal to the outside periphery of the mold, while the lighter material, such as slag, sand from the mold, and various other impurities, are forced to the center of the rising metal and are thus carried into the head portion of the mold. The outside diameter of the body of steel and alloy steel rolls have metal chill pieces inserted in the mold to accelerate cooling of the body of the roll. This chilling is done for two reasons: (1) to get better directional solidification in the overall cooling of the mass of metal in the roll itself, and (2) to get a dense fine-grained metal in the working surface of the roll.

The molds for steel rolls are thoroughly dried before they are closed for pouring. After the metal has been poured into the molds, the rolls are allowed to cool until they are thoroughly solidified. The time that elapses between the pouring and shaking out of the mold, of course, varies with the mass of metal. The rolls are shaken out and taken directly to annealing furnaces where they are given a preliminary anneal, after which they are cleaned or scaled and sent to the roll shop for preliminaary machine work. After the rough machine work is completed the rolls are sent back for further heat treatment. The type of heat treatment given the roll varies with the composition and application of the roll.

Plain carbon steel rolls are made in a range from .50 to 1.00 per cent carbon, with normal manganese, silicon, sulphur and phosphorous. Steel rolls made without alloying elements have good ductile properties but tend to rough up due to abrasive action from similar metals coming in contact with each other. Rolls of this type are used in some roughing operations because of their ductile properties, but are not highly recommended in a rolling operation beyond the roughing stage because they do not hold good surface or pass contour.

Alloy steel rolls, which will vary in composition depending on the use for which they are intended, may be made in a carbon range from .40 up to 2.40 per cent carbon, and may be alloyed with chromium-nickel-molybdenum, chromium-nickel, chromium-molybdenum or, in special cases, further variations of composition. In the category of alloy steel rolls we think first of rolls which are used in the roughing or preliminary operation of rolling steel. Rolls of this type are usually made in the lower carbon ranges, with the alloys varied to meet the needs of the particular application. Alloy steel rolls of this type will hold pass contours longer than unalloyed steel rolls, and will give better surface on the steel delivered from them, for equivalent strength characteristics, than may be had from ordinary steel rolls.

Intermediate and finishing rolls are frequently made of alloy steel to suit the particular application. The carbon is varied to increase or decrease hardness, but with each increase of hardness we lose some ductility and shear resistance. The primary reason for using alloy steel rolls for intermediate roll stands, and more especially for finishing rolls, is because rolls of this type have better strength characteristics than iron rolls. The carbon range for intermediate and finishing rolls made of alloy steel is usually from .60 to 2.40 per cent carbon, alloys being varied to meet local conditions. The product finished on alloy steel rolls will not have as good surface characteristics as a similar product finished on cast iron rolls. However, there are many cases in which the necessary roll strength can be obtained only through the use of alloy steels, and the finish that is obtained from an alloy steel roll is, in general, accepted as satisfactory for semi-finished steel products and structural shapes.

One classification of alloy steel rolls which represents a rather large proportion of the roll tonnage produced each year falls into a rather special case — that is, back-up rolls for four-high mills. Back-up rolls must have good ductility and shear characteristics in the neck or journal areas of the rolls, and the surface of the bodies must be as hard as is practical in order to resist deformation during the rolling process. Therefore, rolls for this particular purpose are usually made in the lower carbon ranges, and the alloys used are those which are suitable to develop the best heat treating characteristics. This type of roll is always a compromise. The ideal situation would be to have more toughness in the journal of the rolls, with the body of the roll having better resistance to deformation. One of the principal reasons that back-up rolls can be made and heat treated to develop the fairly satisfactory compromise properties is because the rolls do not come in contact with the steel passing through the mill, and therefore are not subjected to as much thermal shock as rolls which come in contact with the steel during the rolling operation.

It is now in order to pass along to a general description of the manufacture and application of the other important roll types. The large majority of cast iron rolls which are used in the rolling of steel today are cast with the top and bottom necks in sand molds and the body in an iron mold. The rolls are cast in a vertical position and the metal is put into the mold in the same manner as in making steel rolls — that is, through the bottom neck with a tangential gate which gives a swirling action to the metal. Both plain body and grooved iron rolls have the bodies encased in a chill mold, and the method of making the mold varies as is shown in the accompanying sketches. After the iron rolls are poured, they are allowed to cool to atmospheric temperature and are then taken to the roll shop for machining. In some cases where alloy iron rolls are being produced the rolls are heat treated before the final machining operation. Users of cast iron rolls are familiar with the fact that there are two distinct physical types of cast iron rolls, which are classified as chilled iron and grain iron rolls. The chilled iron roll has a chill or ring around the outside diameter of the body, varying in depth according to specification, in which the carbon is all in the white or combined state. The cross-sectional area of the chilled iron roll can be likened to a case-hardened shaft. On the

outside there will be a chill of hard white iron, while the center area will consist of graphitic gray iron. The chemical composition of the cross-section of the roll will be identical for all practical purposes. The reason for the difference in physical characteristics is the rapid cooling of the outside surface of the roll, retaining the carbon in the combined form. The slow cooling of the center develops the graphite which makes the gray iron center. Every chilled iron roll is made from a chemical composition which is super-saturated with carbon, and therefore will be graphitic unless super-cooling takes place or, as an additional factor, if the chemical balance of the metal is not right.

The clear chill type roll has three zones, which are three different physical manifestations of an identical iron. This statement may seem confusing, but as a more concrete way of demonstrating the point, let us for a minute consider carbon in some of its forms. A diamond, with which you are familiar, is pure carbon in one physical state, and black, greasy graphite, with which you are equally familiar, is carbon just as pure as the diamond but in another physical form.

The method of determining chill depth on a clear chill type roll consists of proper chemical balance of the metal. Three elements play an important factor in changing or varying the depth of the case of chill on any chilled roll. The first element of importance is silicon, which, when added to a heat of chilled metal, will decrease the chill depth, Manganese and sulphur also have an effect upon the depth of chill.

If the sulphur in a chill roll heat is increased without making a proportionate increase in manganese, the chill depth will be increased. However, if manganese and sulphur are kept in proper proportion, sulphur has no effect on chill depth.

Alloying elements also have an effect on the depth of chill. Chromium and molybdenum, which are commonly used in alloy chill rolls, will increase chill depth because they are carbide formers. Nickel in the proportions commonly used, due to its depressing effect on the critical range, has the reverse effect and tends to decrease chill depth.

The thickness of the chill mold used in making chilled iron rolls has no effect upon the chill depth on the roll, within practical limits. This is due to the fact (which has been proven by experimentation) that, within three to four minutes after a roll is cast in a chill, the roll and the chill are no longer in contact because of the expansion of the mold and the contraction of the roll. Therefore, chill molds are designed with walls thick enough to give maximum life as to number of rolls produced and still keep weight within practical limits.

The difference between a grain iron roll and a roll of the clear chill type is that in the grain roll there is no chilled surface or combined carbon shell on the roll. A grain roll is graphitic throughout its entire cross-section. The primary object in the manufacture of grain rolls is to make them with the graphite as fine as possible and with as even a dispersement as possible. The grain type roll is made in a mold identical with that used for making a chilled type roll. The difference in procedure is entirely in the chemistry of the metal from which the rolls are poured. Grain rolls are always alloyed, sometimes with a combination of chromium and molybdenum, sometimes with nickel and chromium, and sometimes with nickel, chromium and molybdenum. But in each case, the silicon is high enough to precipitate graphite even though the metal is cast against a chill mold.

Grain rolls will not give as fine a finish to rolled steel as the chill type roll, but from a practical standpoint they are much more satisfactory than a chill type roll because there is not the line of demarcation which exists between the chilled surface and graphitic core of every clear chill roll, and which is frequently responsible for spalling — also, because it is possible to get deeper penetration of highly refined metal in a grain type roll as compared to the chill of the chilled type roll. and because the grain roll is less sensitive to thermal shock or sudden temperature changes. Cast iron rolls are used in merchant mills, bar mills and structural mills, as well as in the rolling of strip. Where the highest type of finish is required, it is usually advisable to use the clear chill type roll in the finishing operations. However, on larger shapes, it is sometimes impossible to get a sufficient case of chill around the roll to enable the mill to turn out the required shape without penetrating entirely through the chill and into the graphitic iron underneath. In cases of this kind it then becomes advisable to use grain type rolls.

In flat rolling, the chill type roll offers the advantage of better finish, and the depth of penetration of chill

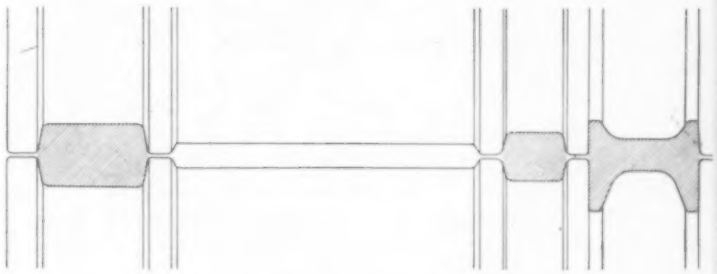


Figure 1 — Roll passes in 40 in. reversing blooming mill for channel and beam blanks.

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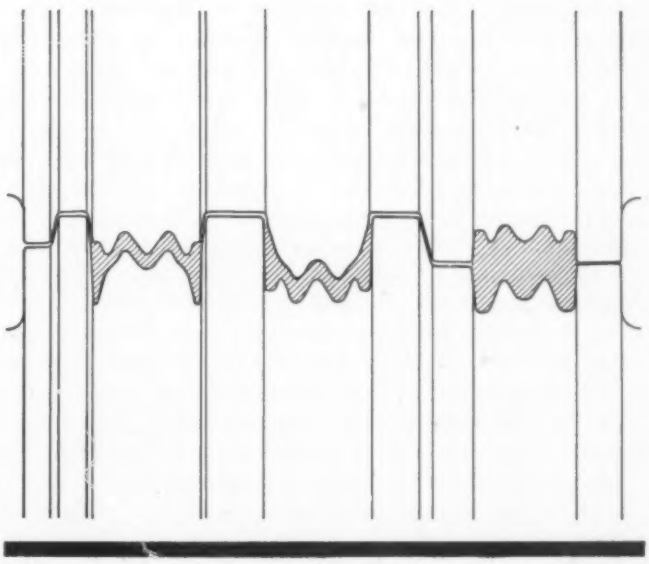
Figure 2 — Breakdown passes for deep arch piling bar in a 32 in. reversing mill.



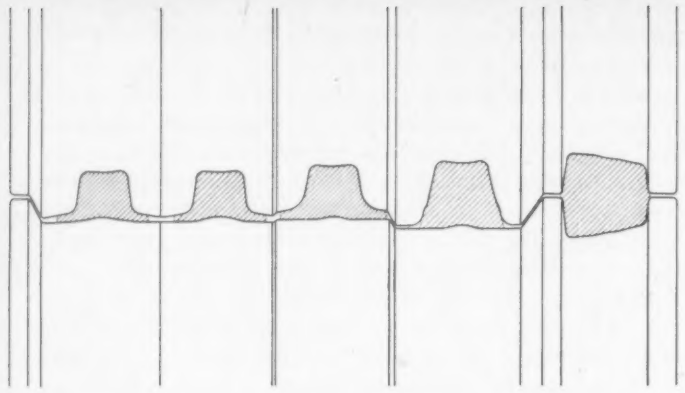


Figure 3 — Rail roughing passes in 32 in. reversing mill rolls.

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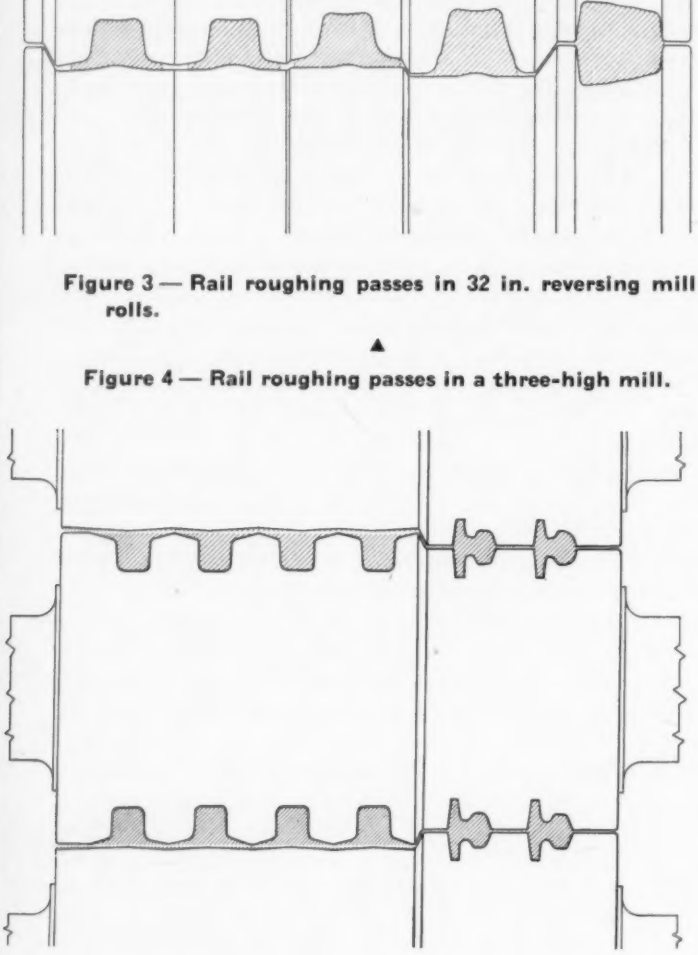
Figure 4 — Rail roughing passes in a three-high mill.



that would be necessary in shape rolling is not required. However, if spalling is a factor in a flat rolling operation, the grain type roll offers a better compromise, as it is less susceptible to a spalling action because there is no definite case on the surface of the roll. One very marked difference between the chill type roll and the grain type roll is the difference in their sensitivity to thermal shock. The chill type roll will definitely break more easily than the grain roll when subjected to sudden temperature changes. However, in both cases, as the hardness of the rolls is increased, they become more dense, and as their density increases, their ability to withstand sudden temperature changes decreases. It is always well in handling a cast iron roll of either the chill or grain type to remember that they are fragile and will not give satisfactory performance unless they are kept at as even an operating temperature as is practical. It is far less harmful to rolls to carefully raise their temperature and run them at consistently high temperatures, or to operate them at low temperatures, than it is to make any sudden change in temperature.

It has been pointed out that the making of rolls is an art rather than a science. It is the desire of many people in the roll business to make it as scientific as possible, but to date we have been handicapped for many reasons. One of the primary reasons is that we have never been able to establish satisfactory data from test bars that could be transposed either mathematically or empirically into roll performance. A second very important reason is the fact that no two mills are exactly similar even when rolling identical sections. There are many variations which make it extremely difficult to transpose a good roll application from one mill to another. Among these variations are heating conditions, water conditions, and variations in the basic roll design which are necessary due to the mechanical arrangements of the mills.

With this thought in mind, I will try to present the problems involved and the reasoning followed in a few roll applications. We point out the factors which a roll maker is forced to take into consideration in supplying a satisfactory product to the roll users. Figure 1 shows a blooming mill roll intended for making billets and beam blanks. The first factor to be considered is that this is a two-high reversing set of rolls. Therefore, the roll material must be sufficiently strong in torque to withstand the constantly reversing stresses. There must be sufficient strength to withstand the shearing action in the necks, and of course, to withstand the heavy pressures applied to the body.

Slippage must be avoided by making a roll that will bite the piece and get it through the mill, first, to avoid sudden shocks which always accompany slippage; secondly, so that production is not cut down due to lost time from roll slippage; and third, to avoid undue heat-checking to the rolls which always accompanies slippage. This heat-checking is caused by localized heat bands which are set up from the frictional heat being added to the heat transmitted from a large piece of steel lying in contact with a localized area of the roll. Resistance to heat-checking in blooming mill rolls can best be obtained, according to the roll maker's viewpoint, by making a roll which will not slip. Resistance to wear is the paramount factor in the mind of roll makers at all times, and especially in a blooming mill roll of the type illustrated. Because of the passes for channel and beam blanks in this roll, side wear in the passes is more of a factor than in the normal blooming mill roll. If the roll cannot be made hard enough to resist this side wear, it will be necessary to take heavy dressing from the roll to bring in the sides of the passes. So in this case, the factors on which we have to compromise are strength in torque, neck strength, resistance to slippage, and wearing properties of the roll. The result the roll maker would arrive at or recommend would probably be an alloy steel roll of an intermediate carbon.

Figure 2 is also a two-high reversing mill. The obvious points to consider are again the resistance to reversing torque and the shock involved. In this case, we must avoid slippage for the same reasons as pointed out in the previous roll. Rolls for an application of this type will again have to be a compromise aimed to resist pass wear and yet have sufficient strength to resist heavy rolling pressures. Due to the modified notch effect in the flanges of the bottom roll, an ideal breaking point has been established so that wear in this particular case will have to be secondary to strength characteristics.

Figure 3 shows a two-high reversing roughing set which takes a bloom from the preceding blooming mill. From this illustration we see that the passes are all of the open type, and that entry should be relatively easy and drafts not too heavy. Therefore, slippage will not be a serious factor. The cross-section of the piece being rolled is not unduly heavy, so that heat-checking from either slippage or heavy hot pieces is not a real problem. The reversing torque of the mill, of course, must be considered. The two outstanding considerations in this application will be resistance to pass wear and neck strength sufficient to resist reversing torque of the mill. The material applied in this case would be alloy steel with the carbon placed in the lower one per cent range.

In the rolling of rails, we are in some cases able to accomplish our object very early in the series of rolls used. From Figure 4 it can be noted that the passes are in a three-high set of rolls. Therefore, reversing torque is not a factor. However, in the case illustrated, the rolls must have sufficient strength to drive two sets of rolls coupled through them to the source of power.

The large mass of rolls give sufficient cross-sectional area so that a relatively weak cast iron can be used to improve the surface of the rolled steel, and the work done subjects the rolls to practically no sudden heavy loads or shock. The pass life is improved by using iron rolls instead of steel rolls, which is, of course, a step in the right direction.

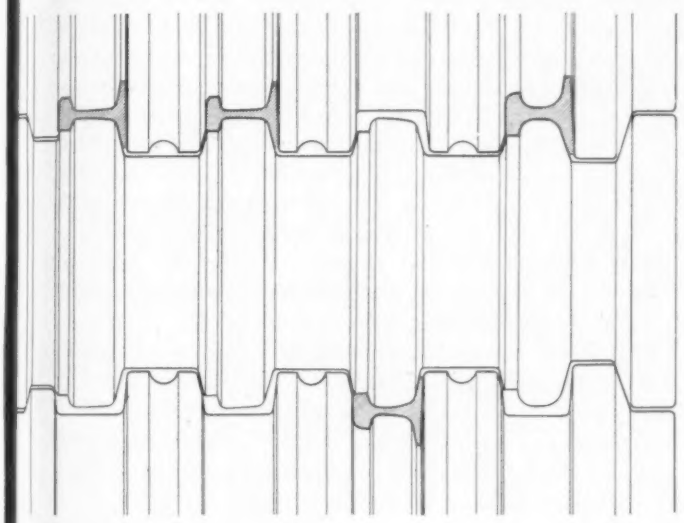


Figure 5 — Intermediate passes for rails in a three-high mill.

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Figure 6 — Finishing passes for rails — two-high stand.

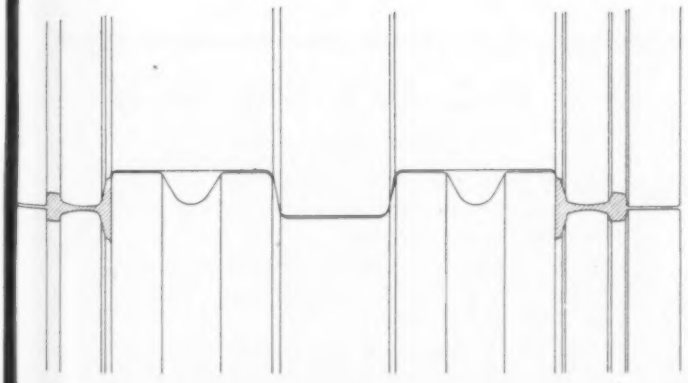

Figure 5 shows the next set of rolls in the sequence of rolling rails. This is again a three-high set, and like the preceding set must drive from both ends. But in the normal course of events, the load is one that is applied rather steadily, with few, if any, sudden shocks. This set of rolls, however, introduces some problems which are more severe than the preceding set in the fact that it represents a series of closed passes which of necessity makes for high collars, which must not break; also for some deep recesses which cut the cross-sectional area of the roll considerably; we also find the notch effect at the bottom of the flanges.

Cast iron of a lower carbon type is used in this application, for it has enough ductility to do the work, and is far superior to alloy steel from the standpoint of resistance to pass wear and finish on the bar. However, design here forces us to make a compromise, for the low carbon iron used in this set will not resist pass wear or finish the bar as well as the irons used in either the preceding or the subsequent set, but we must compromise to get the combination of strength and wear.

Figure 6 shows the finishing set of rail rolls. This set is driven from only one end when in operation and is only two-high, but is not reversed, so it is subjected to a steady pull. The rolls are turned end for end when one pass is worn out, thus keeping the finishing pass always aligned with the mill table roller grooves.

Chilled cast iron rolls can and must be used as rail finishers. They can be used because roll designers have designed the rolls to do a minimum of work, have avoided deep recesses and high collars, and have to all practical purposes eliminated any notch effect. They must be used to hold pass contour and to insure the type of finish demanded in the production of rails.

Without going into the details of developing other sections, it might be of interest to show a condition which leaves the roll maker no choice but to supply a finishing roll of a low carbon alloy type in which consideration is given to strength, and where finish and pass contour are definitely secondary. Figure 7 shows the finishing rolls for deep arch piling bar. The design of the section makes it necessary that the new rolls have grooves cut down to practically neck diameter, which of course weakens the roll due to stress concentration as well as small cross-sectional area. Pass wear is very rapid due to the contour of the section being rolled. Hence, roll life in tons of finished steel is very low.

Work rolls for hot strip mills fall into a category which demands much cooperation between roll users and roll makers. Figure 8 shows the outline of such a roll. This will serve in general to illustrate what strip rolls look like. The cuts below are intended to represent cross-sections through the body of such a roll. One cut is that of a clear chill type, the other is of a grain type roll. In the cut of the grain roll, you will notice that to all practical purposes the cross-section has only one physical characteristic. That is, it is all graphitic iron, more dense, of course, on the outside surface where it was heavily chilled when being made, and gradually developing coarser graphite as we approach the center.

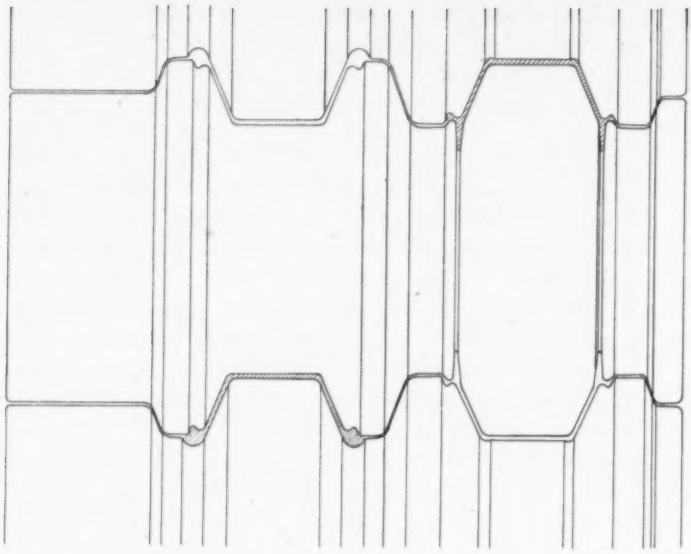

Figure 7 — Finishing passes for deep arch piling bars in three-high stand. (left)

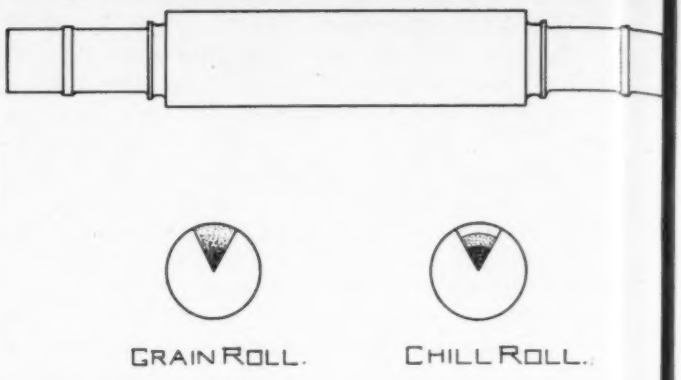

Figure 8 — Outline of hot strip work roll, with sections showing grain structure of grain and chilled roll. (above)

The difference in graphite formation is due entirely to the cooling gradient of different location in the cross-section. Please note carefully that there is no definite line of demarcation in the grain roll cross-section, such as the line in the clear chill cross-section.

In the clear chilled type roll, the shell is white, hard iron in which the carbon is all combined due to very rapid cooling. The center of the roll, while of identical analysis, has the majority of the carbon in graphitic form due to slow cooling, while the intermediate band of metal between the hard chill and the relatively soft center is a mixture of the two physical components.

The users of both grain and chilled type strip work rolls should realize that these rolls in either type are highly alloyed to make them hard and give them the ability to resist wear and bruising. Due to the hardness of work rolls, they are dense and brittle. Rolls such as are commonly used in four-high hot strip mills are so brittle that, if they were not supported or reinforced by backing-up rolls, they would be of no practical use. Due to their density, rolls of the hard alloy types are very sensitive to thermal shock or sudden temperature changes, and care should therefore be used in heating and cooling work rolls, or in letting mill conditions arise which are liable to cause a sudden change of roll temperature. The question as to whether a chill or grain roll should be used in a strip mill is one which must be answered entirely by the roll user. All I can do here is point out the advantages or disadvantages of the two types.

The clear chill type roll will definitely impart a better surface to hot rolled strip than a grain roll. However, the chill type roll will spall more readily, due to the line of demarcation between the chill and the mottled areas, and also because the coefficient of expansion of the dense, hard, outer chill is about twice that of the inner core. Hence, the clear chill type roll must be handled with more care in the mill than a grain roll.

The grain or graphitic type work roll will not impart as good surface to hot rolled strip as the clear chill type roll because of microscopic irregularities of surface which develop as the soft graphite is removed faster than the parent metal during rolling. Also, a graphitic type roll will not make the tight scale surface that is so often required in hot rolled strip. However, for many orders, the grain type roll, properly used, will produce excellent results. The grain type roll does have some marked advantages from a cost standpoint. This graphitic type will not spall as readily as the clear chill roll, for it is made up of one physical component with no clear line of demarcation to form a cleavage plane, and the surface is not as sensitive to thermal shock or impact shock due to the finely dispersed graphite which has a definite cushioning effect.

As pointed out in the opening remarks, a deeply detailed discussion of roll manufacture and application could be carried on to great lengths, and would lose all interest to anyone who was not directly or vitally concerned with the subject. It has been my purpose to point out in this discussion a brief description of the method of manufacture, and the various types of metal commonly used in American rolling mill practice today. I have also attempted to point out a few of the many variables that enter into roll application, and the paramount point that I wish to make is that the best success in any roll application can only be achieved by close cooperation and study of each problem by the roll user and roll maker.

DISCUSSION

PRESENTED BY

LOUIS MOSES, Superintendent, Rail Mill and Roll Department, Bethlehem Steel Company, Sparrows Point, Maryland

ROSS E. BEYNON, Superintendent, Roll Shop Department, Carnegie-Illinois Steel Corporation, Chicago, Illinois

A. E. MURTON, Manager, Roll Department, Continental Foundry and Machine Company, Pittsburgh, Pennsylvania

Louis Moses: Mr. Murton's paper tells us of the various roll materials which are currently found to be best adapted to particular usages, and describes the factors which are considered in making the applications.

It bears repetition that a roll user does not purchase a roll *per se* even though it is ordered, shipped and billed as a commodity. He definitely does purchase the service which a roll will provide. This is measured by the tonnage of satisfactorily rolled product and the effect the roll has had on the mill's operations. A faulty roll or a poor application can cause impeded operation in which losses are greater than any monetary adjustments or replacements could be.

A roll user cannot safely afford to depend upon a single source of supply. When one roll manufacturer makes an outstanding improvement over previously used grades or materials, elementary fairness and good faith require that the user does not reveal the technique employed in making the superior roll to other roll makers. Sometimes a manufacturer who made the superior roll will have disclosed the technique employed. In attempts of the user to obtain a duplicate he must refrain from passing any such information to another maker. All that is called for is to keep each prospective supplier informed of comparative results with details on mill faults or abuse carefully included.

Roll superintendents and mill people can duplicate and multiply many times the following instances of surprising occurrences, but a few will illustrate the point. In a two-high, reversing plate mill we applied a roll material which was tops on a three-high, continuous-direction plate mill. When tried on the two-high reversing mill the roll was found to be a complete failure due to the immediate presence of orange peel. The effect of the reversing action was considered but in the end the conclusion drawn was that the long plates on the two-high applied more sustained heat to the roll and that the material's ability for heat absorption was lower than the regularly used roll.

An identically graded chilled-iron roll on a rod mill which runs at a finishing speed of 3,200 fpm was applied to a faster mill making the same product at 4,200 fpm. Results in the first mill were very satisfactory but in the faster mill an early and prohibitive condition of "shantying" (gathering of steel in the grooves) denied further use and another grade had to be found.

When viewed at an angle a carefully tooled bullhead of a slab or blooming mill roll will exhibit splotches of varying shades of color. Not being a roll maker, I do not know why this is so. It is rather far-fetched to accuse carefully conducted pouring practice of non-uniformity of surface metal. Yet speculations on this, as related to the patterns of fire cracking, might be revealing. Aside from whatever the metallurgical reasons may be for checkered firecracking, the matter was at one time considered from the standpoint of minute stress raisers. The completed surface of a tooled alloy or plain carbon steel roll is far from being smooth. We are all familiar with the soft smooth feel of the hand across one circumferential direction and the positive friction felt in the opposite direction. With new slabbing mill rolls, particular attention was paid to overlapping tool cuts, with their locations recorded. When these rolls came out of the mill after initial runs, the start of a circumferential system of firecracks could be seen. Other similarly graded pairs were initially ground. The mill put up with the slippage occasioned for a number of runs, but at the end of each there was scarcely any firecracking present. On resuming tooling, the usual firecracking returned. If a method is found whereby grinding could be applied and at the same time slippage on heavy drafting be eliminated, the roll maker would have a different conception of the causes of firecracking. At present the matter is treated as one not only of composition but also of varying heat treatments and quenches, I believe.

I presume Mr. Murton's references to slippage apply to that as created at various parts of a groove through varying diameters. But there is always a slippage on every roll, including bull-heads. Within the angle of bite, or arc of contact as it is otherwise termed, there are two distinct components of bar speed as separated by a neutral point where speed of bar and roll surface correspond. The first is when the roll face is moving at a greater speed than the material, the second when the bar emerges faster than the surface speed of the roll. There is thus a constant state of abrasion on the simplest kind of rolling, and this is augmented by the varying speeds created by varying diameters of a grooved roll.

Foundrymen usually react vigorously to a statement that his castings fall into one of two classes, one in which the soundness of surface is paramount to interiors and the other with reverse characteristics, but both meeting certain objectives of usage. It is certain that in roll manufacture the casting must and does meet both specifications.

This brings up the matter of breakage, a discussion on which could be extended. The structural characteristics of rolls are generally well proportioned. Most body breakage is caused by differentials in temperature, these far exceeding accidental causes of extreme loading, as by a cold bar. The latter usually, but not always, result in neck breakage. A cup-shaped neck fracture can generally be ascribed to heat differences of the two volumes; diagonal fractures are associated with excessive pressures. The so-called expansion break is a cause of constant concern to conventional plate mills. An extreme case occurred with a newly installed set of rolls which, after installation, were in the idle mill overnight during cold weather. Ordinary line cooling water was run over them but a zealous millwright became concerned during the night and turned steam into the lines to prevent a freeze-up. In the morning the top roll, 38 in. x 114 in., was found to be parted at its exact center. Another odd case was that of an alloy steel roll having a collar about 36 in. in diameter and some 6 in. wide, with a rail groove on either side. Starting up the mill after a cold night by too rapid rolling, the heat injected into one side of the collar caused a fracture after some six blooms were rolled. The break did not occur at the small diameter of the flange bottom but through the 36 in. diameter. Tremendous pressures would be necessary to fracture either roll, proving Mr. Murton's statement that in this respect rolls are actually fragile to misapplied temperature conditions.

These are only a few of the conditions which make the life of both roll user and maker interesting. Our roll maker is indeed a close partner of the steel industry and

his services must be based upon a wide and complete knowledge of metallurgy in the making of a roll and the conditions of its use. It is necessary in the best interests of our employers that the already close relations be maintained and that the maker be fully informed of results of his product from well kept records.

Ross E. Beynon: In large alloy steel blooming or slabbing rolls, what are the best alloys to use for resistance to shock and also for resistance to fire cracking?

A. E. Murton: That question is more or less one that puts a fellow on the spot. All you can do is to give your own opinion. Blooming and slabbing mills mean large ingots and large pieces leaving the mill. That means high temperatures and relatively heavy work. My preference, from the standpoint of both shock and fire cracking, is a chromium-molybdenum type roll with the carbon held below 80 per cent. My reasons for that are two. In the first place, fire cracking, of course, is a function of differentials of temperature. The roll maker can't control it. The mill is the only one that can. But too much density in a large roll, making for a close, dense-grained pattern, does two things. The density, in the first place, increases the trouble from the standpoint of sudden expansion and contraction. Second, it increases slippage.

A roll will withstand shock better if it is not too hard and if the tensile strength has not been stepped up too high. I realize my statements are probably very controversial with the thoughts of some of the men who are also in the roll making industry. However, those are my ideas, and I work on that basis. There is one other thing I would like to say, in connection with a remark Mr. Moses has made. I realize there are two types of slippage; one in which the piece won't enter the rolls, and the other, natural and necessary slippage because of the reduction of area of the piece, especially as the contour of the pass becomes more irregular. I purposely said very little about hardness, which I think is almost as badly abused as the conviction about tensile strength. As far as hardness is concerned, I think that has been over emphasized, just as much as high tensile strength has been over emphasized.

Some months ago we had a problem, in which we had a brittle roll to begin with — one that was obviously too brittle to do the job. The results weren't good, but in talking with the user, the thought was: "We must get tonnage. That is very essential. We are expecting that at all times." However, we took the position that the roll definitely was misapplied at the time, and we cut the carbon in half in the application. In cutting the carbon in half it softened the roll considerably. The net result was that the rolls not only stopped breaking, which always caused mill delays, but the tonnage over the passes was increased. The reason for this was not the piece bumping against the mill, but the bar going through the mill, instead of grinding along at what we assumed was delivery speed. That is something mill operators, to my mind, could give some thought to. They talk about effective delivery speed. The rolls are going so fast; the pieces are getting out so fast. I am convinced that a difference of hardness in rolls will change slippage, and change the speed of the bar going through the mill. Hardness, in many cases, is over emphasized and misunderstood, and simple hardness will not increase tonnage. More or less it has to be the proper grain size, or, as Mr. Moses put it, a satisfactory operating surface is the ultimate answer.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC. OF

IRON AND STEEL ENGINEER

(Required by the Acts of Congress of August 24, 1912, and March 3, 1933)

Name of Publication: *Iron and Steel Engineer*, published monthly at Pittsburgh Pennsylvania. (Report of October 1, 1945.)

State of Pennsylvania
County of Allegheny

Before me, a notary public in and for the State and county aforesaid, personally appeared Brent Wiley, who, having been duly sworn according to law, deposes and says that he is the editor of the Iron and Steel Engineer and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher: Association of Iron and Steel Engineers, 1010 Empire Building, Pittsburgh, Pennsylvania.

Editor: Brent Wiley, 1010 Empire Building, Pittsburgh, Pennsylvania.

Managing Editor: None.

Business Manager: T. J. Ess, 1010 Empire Building, Pittsburgh, Pennsylvania.

2. That the owner is: Association of Iron and Steel Engineers, 1010 Empire Building, Pittsburgh, Pennsylvania.
No stockholders.

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BRENT WILEY, Editor.

Sworn to and subscribed before me this 20th day of September, 1945.

G. WILLIAM JONES, Jr., Notary Public.

(My commission expires February 9, 1947.)

THE TRAINING OF *Heaters*

. . . . despite the many improvements in automatic controls on continuous furnaces, quality heating is still largely dependent on the skill and experience of the heater . . . .

by L. T. Pearsall and J. L. McHugh

JONES AND LAUGHLIN STEEL CORPORATION

PITTSBURGH, PENNSYLVANIA

▲ DURING the past twenty years great progress has been made in the design of continuous billet heating furnaces, and with this progress the use of instruments and automatic control of draft, temperature, and fuel-air ratio has been greatly extended. A number of papers have been written on the subject of design, instrumentation and control of modern furnaces. However, very little has been said regarding the qualifications and training of the operating personnel. This paper will deal chiefly with the training of the personnel.

Heating steel in the early furnaces, which were designed by rule of thumb was an art. Heaters were brought up on the job and were developed from men whose daily work brought them into more or less contact with the furnaces and who had sufficient ambition to observe and inquire, and so be prepared to take over when the opportunity came. These men were practically self taught, and received very little training from the supervisory personnel. A great many of the men became excellent heaters and have contributed a great deal to improvements in heating. Heating improvements were not born entirely in the minds of the engineers; the heaters have played an important part in them.

As the steel business grew, the demands for better quality, truer sections, and alloy steels grew also. These demands necessarily had their part in increasing fuel cost. In addition, modern mills are capable of rolling greatly increased tonnages. The first factor made more uniform heating necessary and the second factor required increased output from furnaces. Instruments and automatic controls are playing their part in this improvement, and to a certain extent changed the heating of steel from an art to something of a science. Heating is not automatic, however, and it is still necessary to have men on the furnaces who know properly heated steel, and who can judge furnace conditions by visual inspection, and make the necessary adjustments to insure properly heated steel. Instruments and controls give more accurate control of furnace conditions than can be obtained without their use, and make it easier for heaters to establish and maintain the desired conditions, but they will not automatically change furnace conditions to satisfy all the requirements that turn up in a days operation.

During the course of operation, a mill may be required to roll a number of different sections, and numerous grades of steel and billet sizes may be involved. The time required for mill changes for different sections may be from a few minutes to a couple of hours, and is a big factor in the operation of a furnace. A furnace must also produce properly heated billets at the required rate until an order is completed, and at the same time consideration must be given by the heater to the following order, and the furnace so manipulated as to meet these different requirements. All requirements cannot be met automatically, but they must be met, and the training and ingenuity of the heater is the important factor in meeting many of these conditions. Pyrometers with the thermocouples located at properly selected points are of considerable value as an aid to the heater in maintaining desired temperatures, and manual adjustment of fuel input may be eliminated by adding automatic temperature controls so the heater need only set the controls at the temperature desired, to automatically adjust the fuel supply to maintain that temperature. However, automatic temperature control is not automatic

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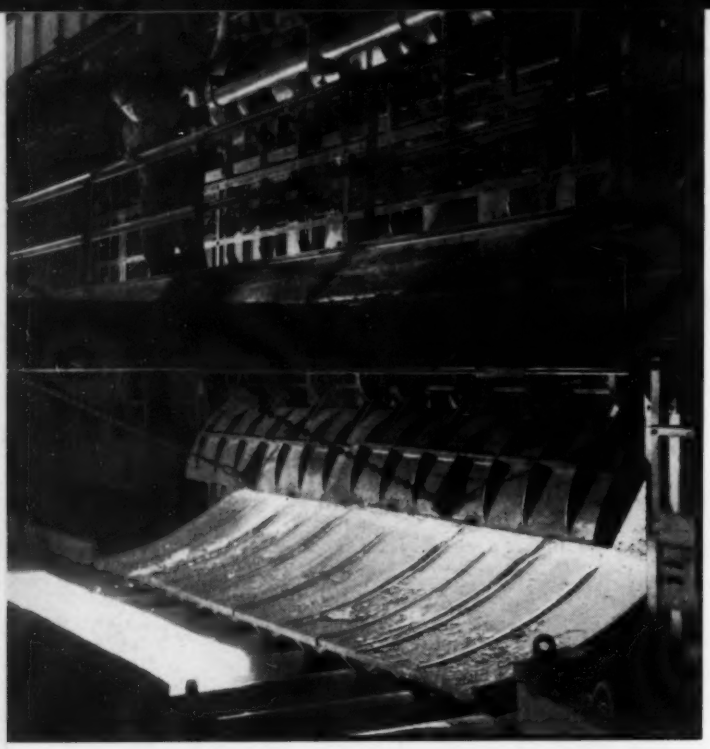


Increased capacity of modern mills and demands for higher quality have focused attention on the heating operation, which has progressed to something of a science.

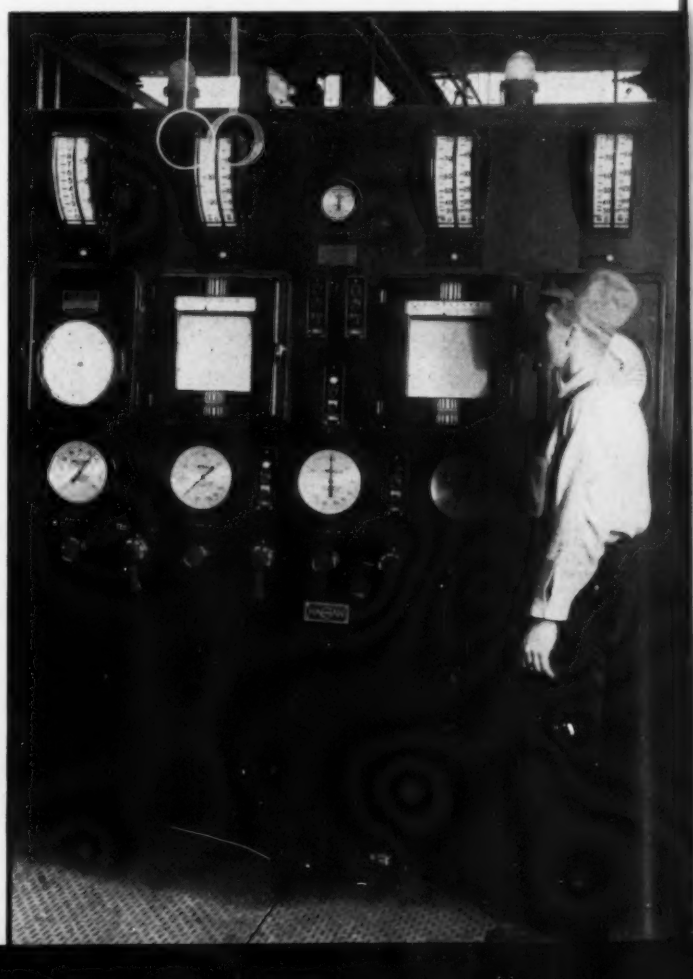
furnace control. Therefore, the training and ingenuity of the heater is a mighty important factor.

Present day demands for quality heating and high production rates make it necessary to provide instruments and controls which to a certain extent must be determined for each individual furnace. These instruments and controls do not of themselves insure the desired results, since their function is only an aid in the attainment of good and efficient heating. They must be intelligently used. It must also be born in mind that instruments and controls are all subject to failure at times, but the furnace must continue to operate and the heater must be able to heat steel without the aid of some or all of these instruments and controls during such periods. However, the heater cannot be expected to heat with the same quality and efficiency, for if this could be done, it would not be possible to justify the installation of controls.

It is advisable to have the maintenance service on controls performed by men trained in this work. As a general rule, they are attached to one of the service departments. The maintenance men very often have under their care a number of installations scattered over considerable territory. The work should be arranged in such a manner that each installation receives regular inspection visits, at which time necessary adjustments can be made and worn parts replaced, so as to reduce actual failure to a minimum. Even under a very good maintenance program, occasional failures will occur and the service man may not immediately be available. Therefore it is desirable to have a heater sufficiently familiar with the functions and construction of the controls so that he at least can make minor adjustments or repairs to keep the equipment in operation. It is very essential to train heaters, especially those who have previously heated furnaces without control equipment, to keep instruments and controls in good working order at all times. It is only natural that men who have operated furnaces without controls will be more skeptical of them than the men who have always had them, and if the controls frequently go out of order it is all the harder to convince the heater that the equipment is a help to him. When the instruments are poorly maintained, some of them will form the opinion that they can do better without them than with them. Therefore, it is extremely important to keep the equipment in good operating condition.

The qualification for a good heater is essentially the same as for many other responsible jobs. He should have common sense, good judgment and a certain amount of instinct. The heater of today should have the ability possessed by the old-time heater to judge the quality of the heating from the appearances of the steel as it passes through the furnace, and to tell by visual inspection of the interior of the furnace if the conditions are correct to give desired results. It is desirable that the heater be physically active. Improvements in furnace design and the addition of instruments and controls very frequently reduce the steps required, but nevertheless the heater still must get around a great deal in a day's operation. It is very desirable that the heater know something of the chemistry of combustion; frequently, however, this is not the case. Today we have combustion engineers who are of great help in furnace operation and in training heaters. The close cooperation of combustion engineer and heater not only helps to make good heaters, but also helps to make good combustion engineers. The heater should know enough about combustion processes

Instruments and automatic controls have contributed materially to the quality of heating, although well trained heaters are most essential.



to be able to understand what the engineer is driving at when he suggests changes, and their probable effect on furnace conditions. He should be able to discuss suggested changes with the engineer in a language that they both understand.

If the man selected to be a heater has a high school education or some technical training along the lines of combustion, metallurgical, or mechanical engineering, it is a great help to him. However, such education is not absolutely necessary, as some of the best heaters in the business have had very little education in schools. Their education has been in experience, and many of them have really become educated heaters from observation and hard work.

Training of a heater should be started at the beginning. If this is not done, heaters will very often get ideas which are not sound, and once they are formed it is sometimes difficult to change them. Very often the supervisory force in a rolling mill does not have as much time to spend with the men they are breaking in as heaters as they would like, nor do they always have the thorough knowledge of instruments and controls they should have in order to teach young heaters. Therefore, it is necessary that instrument men, combustion engineers, metallurgists, and rollers take an active part in the proper training of a heater. There should be a close, cooperative contact between the young heater, the combustion engineer and instrument men at all times. The combustion engineer should give him the benefit of his knowledge regarding the theory of combustion and controls, and reasons for their use. The combustion engineer should help him with suggestions towards increasing the efficiency of the furnace operation, and the heater should accept these suggestions in the proper spirit, try them, and be able to give the combustion engineer an intelligent report on the results obtained. Similarly, the heater should be able to make suggestions that are a help to the engineer. As stated before, close cooperation not only helps to make good heaters, but also good engineers.

A very important part of a heater's training is to make him thoroughly familiar with different grades of steel, and of the effect of heat on the various grades. It is essential that he be taught the grades which can be heated at a rapid rate, and those that must be heated at a slow rate.

This part of his training obviously is more a responsibility of the supervisory personnel and metallurgists, than that of the engineer. If he is not taught this part of his job at the beginning, and is left to find out for himself, his education might be very costly. The roller can be of great help to the young heater by giving him the benefit of his knowledge of the kind of heat necessary to produce a good product from the various grades to be rolled. Above all, the young heater should be taught cooperation with the roller as this insures more efficient operation and a better product.

Today, furnaces are usually well designed for the purposes intended, but there are still many chances for improvements in the intelligent operation of the furnace. New ideas may be born in the minds of properly trained practical men. Ten years from now, furnaces and equipment will be greatly improved from what they are today, and the better the heater is trained, and the closer his cooperation with the supervisory force and the engineer, the greater will be the advances in furnace design and efficiency.

The important part of training a heater is to start at the very beginning. He must not be permitted to start off and drift for himself. His training should be closely supervised from the very beginning. If this is done, the majority of men selected for heaters should become good heaters, and better and more efficient heating will be the result.

DISCUSSION

PRESENTED BY

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JOHN R. GREEN, Manager of Steel and Ceramic Division, The Brown Instrument Company, Pittsburgh, Pennsylvania

M. J. BRADLEY, Market Extension Division, Leeds and Northrup Company, Philadelphia, Pennsylvania

A. L. Hollinger: The viewpoint expressed in this paper is important and could well be extended to other subjects. One of the attitudes of the heater is that these automatic control instruments are provided to replace his experience, and that prejudices the heater against instruments. If it can be established that instruments are to supplement the heater's experience and skill we have gone a long way; and that should be done the moment the job is started, in an effort to instill in the heater that control equipment will make his position more important and his responsibility greater than it was before.

E. B. Williams: During the time I have been working with Mr. McHugh, I have seen the advancement made by the heater when he receives the cooperation of the supervisors, combustion engineer and metallurgical engineer on the job. The following is an example of how such supervision has greatly assisted in increasing the production and performance of a furnace. A radical change was made on the heating and soaking zones of No. 18 mill, and due to this change, the heater had to be taught how to use a new type of furnace because the furnace characteristics had been changed. Since most of the heaters on the job were old hands, they insisted on heating as they had done previously and ran into a little difficulty. Through the aid of Mr. McHugh and the engineering departments, the difficulty was corrected, and since then with properly trained heaters, satisfactory heating results on this furnace were obtained.

There is one point in this paper that I believe Mr. McHugh should have emphasized more strenuously; that is, the future heater should be required to have a high school education and some technical training along the lines of combustion, metallurgical, and mechanical engineering, due to the fact that the heating of steel has advanced with respect to differences in alloys, drafts, and closer tolerances.

G. R. McDermott: I would like to ask some of the operators what their experience has been in automatically controlling temperature of steel leaving the furnace by the use of radiation pyrometers sighting directly upon the steel about to be discharged. How would the heaters feel regarding such an application of control equipment?

J. L. McHugh: As I stated, these controls only give us furnace temperatures. For various reasons, such as billet sizes, rusty billets and scale, different billets soak up heat differently. We may have a furnace temperature of 2400-2500 F, but the billets are not necessarily at that same temperature. I think if there were some way by which the heater definitely knew the temperature of his billet, instead of the temperature of the furnace, it would be a distinct advantage. He must learn the furnace temperature he requires in order to gain a certain billet temperature. It can be influenced by numerous things, such as the size of the billet, and the speed at which the billets are going through the furnace. It would be a great aid if we had some way of knowing the temperature of the billet in the furnace instead of the temperature of the furnace.

Louis Moses: Mr. McDermott's question is an important one because instrument indications of furnace conditions do not necessarily measure the relative temperatures of a long billet from end to end, nor do they show the difference between tops and bottoms of blooms as discharged from the furnace.

Accuracy of gauge and section as well as yields from continuous mills are dependent upon a uniform temperature from end to end of the long billet. A cold middle portion, hot or cold ends, one end cold, etc., will seriously interfere with mill control. Pulls, pushing, overfills and underfills, will result otherwise. A recording pyrometer is installed between early stands of some of the mills at Sparrows Point to measure the bar as it passes by. There is a sufficient time lag between the passing of the front and back ends to enable the instrument to register any difference or the chart can be speeded up to indicate whatever difference there may be between the ends in time for the heater to take steps to correct an adverse condition.

Some fifteen years ago a desired result was dependent upon having nearly uniform temperatures between the heated tops and bottoms of large blooms. There was no available means to determine this except by readings from two opticals as taken simultaneously. Dr. Bradley devised a long range radiation machine to register and record such differences at a distance of some ten feet. The instrument was sighted across the bottom pass line of the mill reducing the blooms to a section, so that when the bar emerged from the nearest adjacent pass the top of the bloom was exposed to the focused tube. Two passes further on the manipulation of the bar brought that side corresponding to the bloom bottom into view. Except for a natural drop in temperature because of some 10 sec time interval, the desired readings were obtained and the furnace burners adjusted from time to time as required. This installation was viewed at first by the heaters as treading on their sacred rights as arbiters of what the heating should be but they soon learned to rely on it and sometimes were lost when it was out of order.

There are a number of considerations concerning the type of candidate and training provided to make a good heater. Each plant has many factors to consider, as a heating job is generally a good one and a greatly desired promotion. In my experience on a rail mill, it is found that recorders become good candidates because of their close association with the furnaces. They are fully familiar with the vagaries which develop with hot and cold steel supplies, mill delays, etc. and are familiar with the influence of time upon the decisions which the heater must make. By observation they learn what the heater must know under all circumstances to effect good heating with least loss of time or product. Their familiarity with mill problems and conditions has contributed not a little to becoming good heaters and the time-honored feuds between the position and the roller has been largely eliminated. However important his work is recognized to be, a heater without this prior experience tends to over rate his job as being the pivotable point of the mill and is often deaf for a long time to any other consideration. I would think that a requisite should be high school education but many a natural has obtained the equivalent education for the purpose through intelligent work in and around the mills and pits.

J. L. McHugh: We give the combustion engineers a free rein and cooperate with them, and have found that this helps a great deal with our problems. As stated previously, these controls give the furnace temperature, but it is possible to find the temperature of a billet after it leaves the furnace by placing a pyrometer some place along the line of the mill. We found it an advantage to have it as close to the furnace as possible, and placed it between the second and third stands, as at that point our billet has very little scale. This gives the heater an actual temperature at this point and helps him in arriving at the furnace temperatures required to give certain billet temperatures. It was asked whether knowing the temperature of the billet in the furnace would be of any help. Definitely yes, although a pyrometer along the mill gives us a pretty good idea of our billet temperature. There is no definite way of knowing just how fast we are heating the billet and with some grades of steel this is extremely important. Some grades should be charged at relatively low temperatures and heated slowly, whereas other grades can be charged at high temperatures and heated quickly. One of the important parts of a heater's work is to watch the temperature at the charging end of the furnace as there may be numerous grades of steel which require different charging end temperatures. If he had some definite way of knowing just how fast the billet is heating as it moves through the furnace, it would be an advantage.

The question was asked whether an excess or deficiency of air should be used. This has been the subject of many a discussion and argument. The only way I can answer that question is to say that most of the combustion engineers have a pretty good knowledge of the proper mixture of air and fuel, and we have found that

by following their suggestions in this respect we secure very good results. We believe in most cases the proper mixture of air and fuel to give maximum heating efficiency depends a great deal on conditions such as grades of steel, and that the most efficient mixture must be worked out for each furnace. It may be different for different furnaces, depending on what you want to do in each furnace.

John R. Green: In the average continuous furnace system, the temperature of the steel itself gradually increases until it is discharged at some temperature, say 2000 F, which is considerably lower than the maximum combustion chamber temperature (approximately 2400 F) in the so-called soaking zone. One of the problems in operating a reheating furnace is to outguess mill delay or charging rate, as to what temperature should be set on the final heating zone. For example, an extended mill delay will finally soak out the entire furnace and its steel charge to the temperature set on the final combustion chamber (approximately 2400 F). Actually, what is required is a saturation temperature at or below, the desired final steel temperature (2000 F) in order to avoid overheating, decarburization, excess scale, etc. There is considerable information to be gained in taking temperatures at the charging end of the furnace, which is the first point responding to mill delays or changes in charging rate.

As the load on the furnace decreases, the temperature at the back end has a tendency to rise. By selecting such a point for furnace temperature measurement, which is normally below that of the desired steel discharge temperature, the increase of temperature at this point can be used to decrease, either manually or automatically, the control setting of the furnace discharge zone. Such a system of operation assists materially in maintaining desired steel discharge temperatures by establishing, from furnace temperature in the charging end, a furnace temperature in the discharge zone which may be between a maximum allowable for refractory life and a minimum of actual steel temperature after an extended holding period.

M. J. Bradley: Mr. McDermott's question refers to a method of controlling the temperature of slabs about to be pushed from a reheating furnace, by measuring the temperature of the slab surface directly with a radiation pyrometer. This is accomplished by installing an open-end refractory tube through the furnace roof and extending it down through the furnace to within a few inches of the slab. The tube eliminates radiation from the flame and walls, and permits the radiation unit to be sighted directly on the slab surface. The refractory tube should not be installed immediately in front of a burner; neither should it extend too close to the slab or it might be broken by contact with a slab which may buckle upward during pushing. There are between one and two hundred of these installations on reheating furnaces and from all reports they are working out very satisfactorily.

The paper has stressed the training which is desirable for operators in charge of furnaces equipped with automatic controls, such as temperature, pressure, air-fuel ratio, etc. To get the best results from the controls, the operator should understand how the controls function and realize that they can only function in the way that they are set. He should know if the set relationships are correct for the conditions that he wishes to maintain. The automatic controls are his tools with which to control certain repeative conditions. If he does not understand their functions, he may be tempted to use them as an alibi for poor results. The human element is very important, and it is the intelligent, honest operation of the controls which demonstrates their advantages.

I should like to mention another factor which is very important, namely, the maintenance of the control units. It has been stated that control units are too complicated for ordinary service men to maintain in correct operating condition. The present trend is to put more and more responsibility on automatic controls. The more functions that are included, the more complicated the control units must be. We are passing from an age of independent control units to the coordinated control systems in which pressure and air-fuel ratio are recognized as fundamentals in temperature control and these, in turn, are correlated with furnace operation. Thus, the trend is to more complicated or correlated control systems. It would seem that managements which provide the funds to buy expensive control units would also supply the funds to provide a competent maintenance personnel to insure that the controls are in first-class working condition and doing the functions correctly for which they were purchased.

Mahaney DISCUSSION

(*Continued from page 50*)

has avoided the pitfall of this possibility by establishing the limits of reliability in some of his preliminary work.

One cannot avoid the temptation to ask for more information than can possibly be told. It would be of interest to know the changes made in open hearth practice to improve surface quality, or the source of typical defects.

From the study made on billets, does it appear reasonable that some sort of inspection of ingots or slabs, or a camera at the blooming mill would be helpful in the study of defects in strip, such as seams, slivers or bad edges?

In conclusion the authors are to be commended for the cooperation developed in this study — first, the cooperation among various departments of the mill, and second, the cooperation in bringing several methods of attack to solve a perplexing and important production problem.

E. W. Mahaney: In answer to Mr. Diehl's question, we can say that the changes in open hearth practices resulted from correlations between our preliminary test results and various characteristics of practice, such as uniformity and quality of working, tapping and pouring techniques, etc., as well as from experimentation with deoxidation materials and practices. Improvements were made, we feel, more from a reduction in variability of these characteristics than from any radical changes which were made.

We feel that the camera set-up is invaluable as an aid to studying semi-finished steel surface quality, and we use it for all of our production, including considerable flat-rolled tonnages. We can say that it has materially improved our soaking pit heating practice.

THE MANUFACTURE OF

Butt-Welded Pipe

. . . . important advantages of the Fretz-Moon process for pipe manufacture are reduced costs of operation and maintenance, high quality and high yield . . . .

by N. W. Richardson

SALEM ENGINEERING COMPANY

SALEM, OHIO

▲ THE development of the first continuous butt weld pipe mill was started back in the year 1911 by John Moon. Later, with S. S. Fretz, Jr., he undertook the first rude experiments on continuous butt weld pipe and the first patents were issued in 1923. It was called the Fretz-Moon pipe process. The first experimental mill and furnace were constructed at a cost of $525.00 and produced ⅛ in. pipe. The original company, which started production in 1923, was known as the Fretz-Moon Tube Company. The plant was located in Butler, Pennsylvania, and manufactured ⅛ in. to 1 in. standard pipe with an annual tonnage of approximately 42,000 tons. The cost of construction of this plant amounted to approximately $27,000.00. A second mill started into operation in 1924 manufacturing ⅜ in. to 2½ in. pipe with an approximate annual capacity of 75,000 tons.

Although several large companies were vitally interested in the Fretz-Moon method, it was not until 1938 that a continuous butt weld pipe mill was completed in another plant. This modern Fretz-Moon type mill started production at the Spang Chalfant division of National Supply Company in 1938 and was equipped to make pipe continuously in sizes ranging from ⅜ in. to 3 in. inclusive, with an approximate annual tonnage of 85,000 tons. Since that time there have been a total of 8 mills installed in United States and 10 in foreign countries. Experience gained on the first mills made possible redesigning the equipment so that it ranks with the most modern steel finishing machinery.

The continuous butt weld type mill is truly a continuous process, starting with the coiled skelp and ending with finished pipe. The coils of skelp are welded together

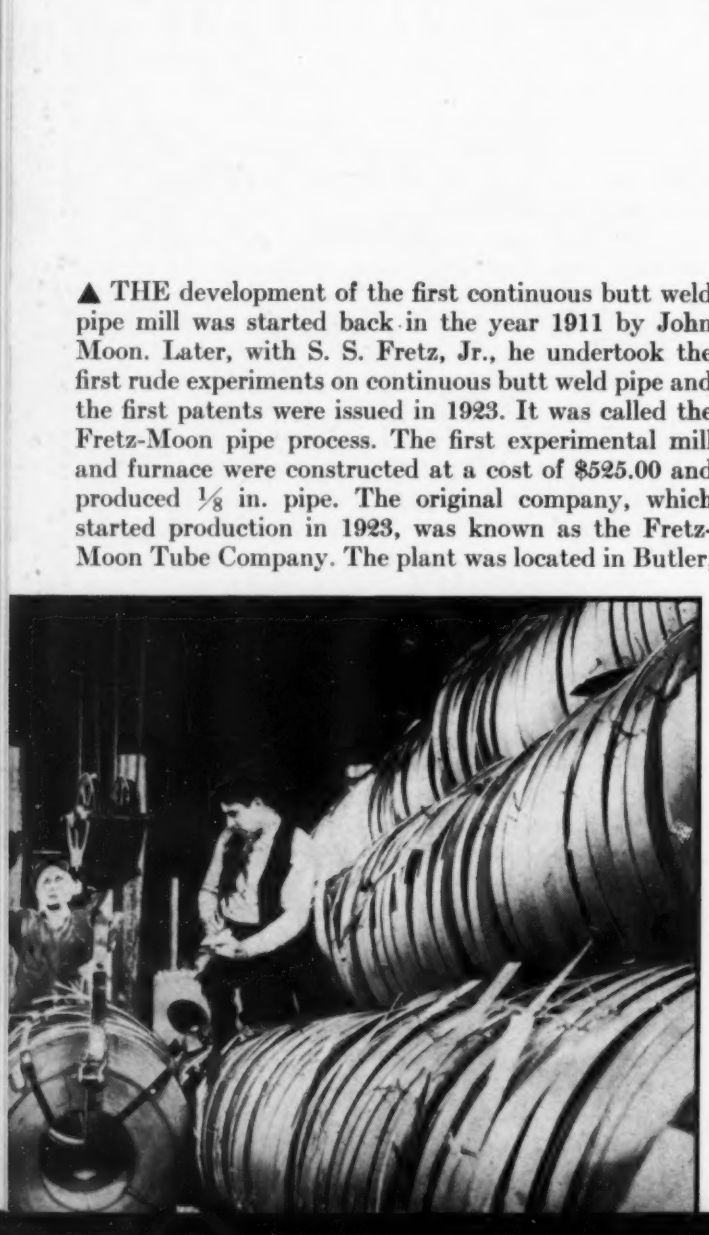

Figure 1 — Coils of steel skelp are removed from the storage pile by crane to the production line. Every coil of skelp is carefully weighed and checked.

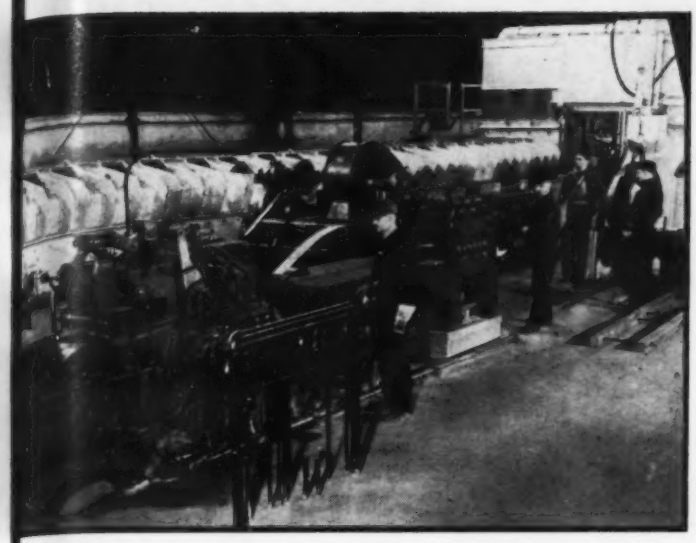

Figure 2 — Leveling rolls flatten the skelp as it comes from the spools and the ends of the skelp reels are flash welded into a continuous strip.

end to end, passed through the heating furnace and a series of forming rolls where the pipe is formed, sized and cut to length without a single break in the entire operation.

Taking for example the first modern mill built, the coils of flat steel skelp, made to the proper metallurgical and physical specifications, 35 to 38 in. in diameter and containing 185 to 550 ft of skelp weighing from 600 to 1800 lb, are weighed and checked for size and gauge before being placed on the unreeling spools. From the spool the one end of the skelp is fed into the roller leveler which levels or "irons" the reeled skelp flat and straight, so that it will pass around the loop table and through the furnace without kinking or bending. After the tail end of the first coil is reached, the starting end of another coil is run through to the flash welding machine where the ends of the two coils are joined together to form a continuous ribbon. After the weld is made, the skelp passes through a trimming machine where the excess metal from welding is removed. The skelp is payed out quickly by means of pinch rolls from the trimming machine to fill up the loop table in order to have adequate running time until the subsequent weld is made.

Skelp from the loop table enters the furnace which is 146 ft in length and is fired by 274 small gas burners. This furnace does not follow conventional furnace design or operation. Cold skelp is brought up to welding temperature in a minimum of 30 seconds. This operation is of the utmost importance in this process, due to the fact that "flash" or uneven heat is necessary. The edges of the skelp must approach the softening point in order to insure proper welding at a temperature of approximately 2850 F. Inasmuch as the strip is pulled through the furnace entirely by means of the pipe welding mill at the discharge end, it is essential that the center of the strip is not overheated, as it must retain enough strength to pull itself through.

As the skelp moves through the furnace at speeds up to 400 fpm, the edges are heated up to approximate welding temperature. As the strip emerges from the furnace, jets of air are played upon the edges of the skelp, increasing the temperature 100 to 200 degrees or up to the mean welding temperature. This blast of air played on the edges of the skelp as it leaves the furnace not only causes an increase in temperature due to oxidation, but also removes loose scale from the welding edges of the skelp. The skelp then passes through six pairs of grooved rolls arranged in three sets, each set consisting of a pair of vertical and a pair of horizontal rolls.

The first pair of rolls forms the skelp into an oval with the edges still apart. The second pair of rolls brings the pipe into an approximate round with the edges in contact with each other and the welding operation takes place here. Subsequent rolls furnish traction sufficient to insure uniform travel of the skelp through the unit.

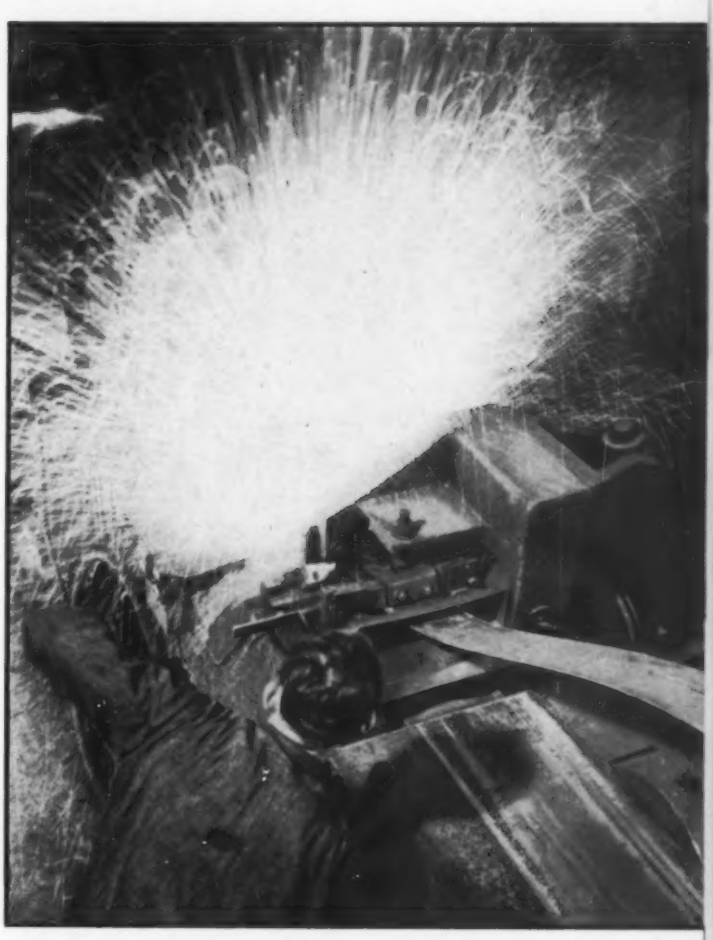

Figure 3 — A trimming machine finishes the welded ends.

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Figure 4 — Charging end of furnace showing loop table.

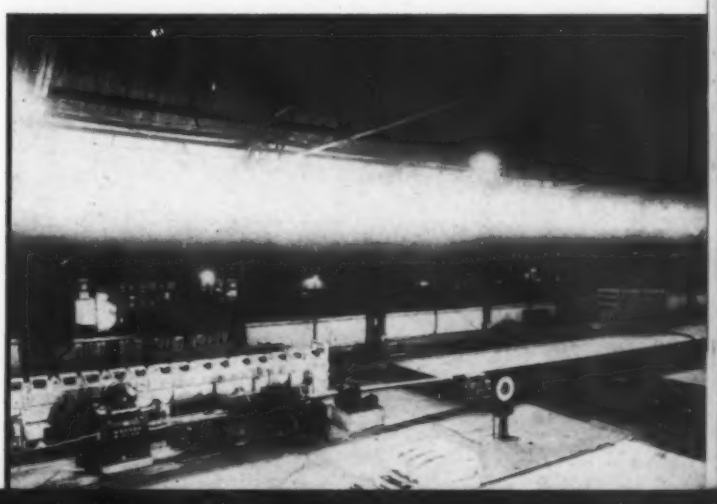


Figure 5 — Balance of heating furnace with recuperator superstructure.

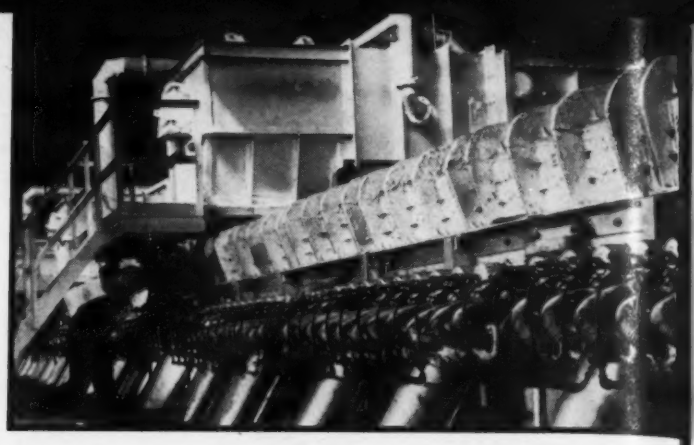


Figure 6 — Closeup of pyrometrically controlled furnace through which skelp passes to the welding rolls. The superstructure is the air recuperator. Gas is fed through the 274 gas burners aligned on both sides of the furnace.

After the pipe is rolled into shape, it is cut to uniform length by means of a flying hot saw. This saw is synchronously tied in with the speed of the mill so that it automatically cuts the pipe into the exact desired lengths running from 20 ft up to 55 ft.

Finished pipe, after being cut in lengths, is transferred to a traveling cooling rack to permit slight cooling before the descaling operation. The pipe, still at red heat, is fed into a descaler consisting of three pairs of rolls, where the final reduction is made and scale is loosened and removed both internally and externally. The pipe is then passed onto conveyor racks for final cooling. After leaving the cooling racks, the pipe goes into the finishing department where it is straightened and each section of pipe clamped into a hydrostatic testing machine where it is subjected to a high pressure water test in excess of its rated pressure. The pipe is then threaded on high speed threading machines of special design.

After threading, part of the finished pipe is pickled and galvanized with a uniform protective coating of spelter applied inside and outside, and is then ready for the warehouse.

Scale loss in the entire operation amounts to approximately 3½ per cent and is caused largely by the air blast at the end of the furnace. Other losses, including finishing loss, total about 1½ per cent, making a total yield of approximately 95 per cent into finished pipe from skelp received at the cold end of the mill. For short periods of time various manufacturers with improved operating technique have been obtaining up to 98 per cent yield or higher.

Production from a smaller mill making ½-3 in. pipe for periods of 8 hours runs as follows:

Pipe size, in.	Tons per hour
½	9.1
¾	11.5
1	13.7
1¼	17
1½	19.4
2	21.5
2½	21.7
3	23.2

Production from larger mills making 1-4 in. pipe for periods of 8 hours range as follows:

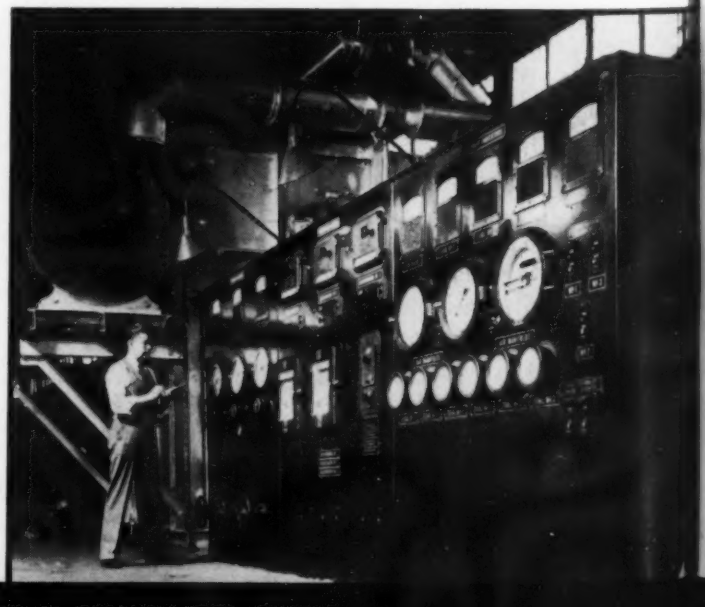
Pipe size, in.	Tons per hour
1	14.2
1¼	17.95
1½	19.9
2	25.6
2½	26.1
3	27.9
4	29.1

All of these tonnages are based on 1940 figures.

Plants in the United States manufacturing pipe by means of the Fretz-Moon system are as follows:

Company	Location	No. of mills	Size pipe rolled, in.
Fretz-Moon Tube Co.	Butler, Pa.	2	⅛-2½
Spang Chalfant Co.	Etna, Pa.	2	⅜-4
Republic Steel Corp.	Youngstown, Ohio	2	½-4
Youngstown Sheet and Tube Co.	Youngstown, Ohio	1	½-3
Youngstown Sheet and Tube Co.	Indiana Harbor	1	½-3
Bethlehem Steel Co.	Sparrows Point, Md.	2	½-4
Wheeling Steel Corp.	Benwood, W. Va.	1	½-3

Figure 7 — Electric control panel board where the entire heating sequence is automatically maintained and recorded by instruments of scientific precision.



Mills are also in production in England, Australia, Russia, Germany and Canada.

The furnace comprises the largest portion of the Fretz-Moon system so we will attempt to give the pertinent construction and operational data on a particular installation for pipe ranging from ⅜ in. to 3 in. inclusive.

The furnace is 146 ft long, with a width of 16 in. at the bottom inside and 27 in. at the top, and a height of 21 in. The first 30 ft of length is utilized as a preheating chamber which is heated by spent flue gases from the hotter portion of the furnace. The heating chamber is 116 ft long and is heated by means of 274 nozzle mixing burners utilizing natural gas of 1100 Btu per cu ft. Each burner has a rated capacity of 175 cu ft of natural gas per hr. Gas flow equipment for the furnace is based on not exceeding 40,000 cu ft per hr. Reports show that a average of approximately 4,000 cu ft of natural gas per ton is required based on ½-3 in. pipe.

Burners are of special design so as to afford a wide range of flame adjustment, and are provided with spiral vanes in order to give rapid mixing and combustion. Combustion air is preheated to about 900 F with the waste products of combustion by means of metallic needle type recuperators. Flexible tubing is used to bring the preheated air from the hot air headers to the burner proper in order to allow for any expansion of the furnace structure.

Skelp enters the furnace and is carried through the preheat zone on a series of heat-resisting refractory idler rolls. In the heating zone skelp passes over tubular water cooled skids running traversely across the furnace chamber at short intervals.

The heating chamber is divided into three separate zones, each with individual controls, recuperator, dilution air fan and fuel-air ratio control, so as to give proper furnace regulation. All furnace controls and instruments are grouped on one central panel board and include the following:

One three-point pyrometer recording recuperator temperature.

One radiation pyrometer recorder showing furnace temperature at discharge end.

One selective indicating pyrometer which may be used on any one of ten points in the recuperative system.

Three draft indicators, showing draft at a point where waste gases leave the recuperator.

One gauge showing draft where waste gases leave the preheating chamber.

One gauge showing stack draft.

One recording tachometer showing strip speed in feet per minute.

One indicating and recording gas flowmeter.

Six indicating gauges showing gas and air pressure in each zone.

Three fuel-air ratio controls with gauges.

Each recuperator is composed of 21 chrome steel metallic needle type elements through which combustion air is forced, the elements being heated by waste products of combustion up to a temperature of 900 to 1000 F. Each recuperator takes about one-fourth of the products of combustion, the remaining gases passing out through the preheating chamber.

Automatic temperature control is provided on each recuperator to govern preheat temperature and to guard against excessive temperatures which might endanger the metallic elements. Temperature within the recuperator temperature is maintained at 1750-1850 F by diluting the products of combustion entering the recuperators with free air, this air being controlled by a motor-operated valve actuated from the controlling pyrometer.

Recuperation adds to the fuel economy of the furnace, as well as assisting in providing the necessary high flame temperature and rapid combustion required with this type of heating.

All flue gases from the recuperators are collected into one main tie flue located underground and leading to a stack outside of the building. The stack draft from the recuperators runs about .65 in. water column. Gas pres-

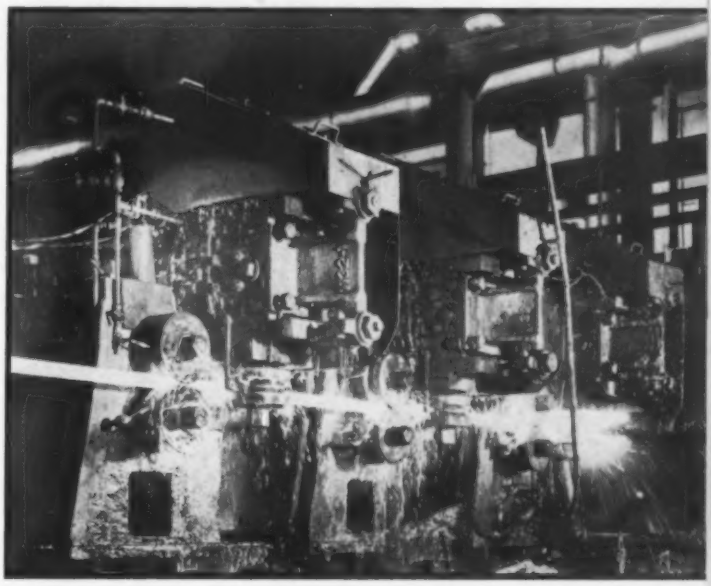
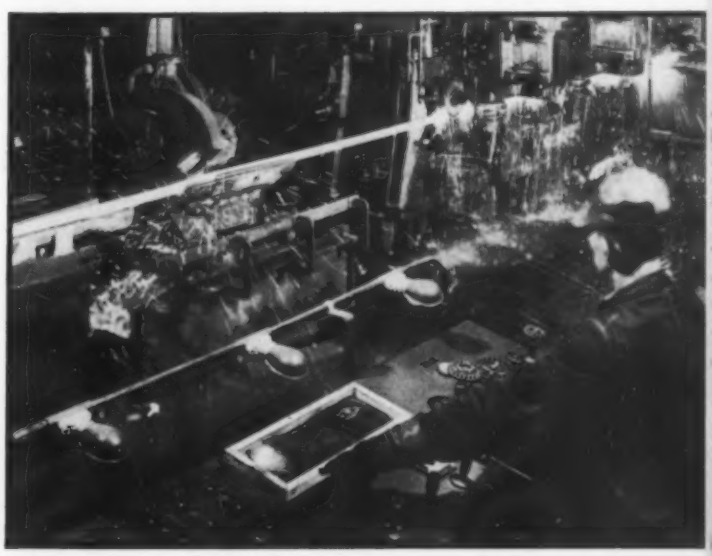


Figure 8 — Ingeniously designed welding rolls where the white hot skelp is accurately shaped and securely welded into pipe immediately after it emerges from the furnace.

▲

Figure 9 — Mechanical control of entire mill made from master control board in foreground. In center background is shuttle saw which cuts the continuous length of hot pipe into the desired uniform lengths



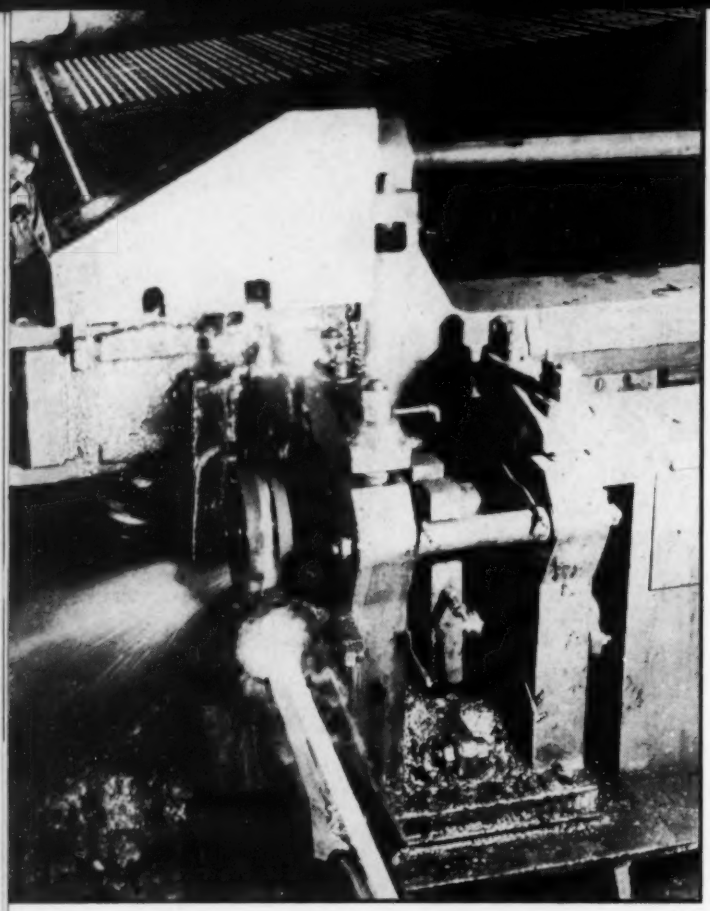


Figure 10 — The pipe still at red heat is fed into rolls for the final reducing operation, which also breaks away all scale, and then passes to the conveyor racks for final cooling.

sure is maintained at about 8 in. in the manifold. Combustion air, which is furnished by a single blower, is held at a manifold pressure of about 7 in. water column.

Rate of heat release within the furnace is approximately 100,000 Btu per hr per cu ft of furnace volume, and the furnace, with a capacity of over 20 tons per hr and a hearth area of 195 sq ft, gives a production rate of over 200 lb per sq ft of hearth area per hr. This is, of course, possible only with a flash heat such as used in this process. Strip or skelp speeds range 75-300 fpm, giving a heating time of ½-2 minutes.

Furnace temperature at the discharge end is approximately 2700 F, while the skelp emerges at about 2400 F, although the edges, of course, are hotter due to the direct flame impingement from the burners.

High temperatures encountered in the furnace necessitate the use of high grade refractories throughout the entire furnace structure. The furnace bottom consists of chrome refractories, and is so designed that scale may be removed from slag pockets provided along the entire furnace bottom. The roof of the furnace is made in sections, each consisting of a cast steel bung lined with high grade refractories. These bungs are easily removable in order to provide quick access to the interior of the furnace for maintenance purposes.

The entire pipe mill is electrically operated and controlled from two central points. Equipment on the charging end, including roller leveler, welder, trimmer and pinch rolls, is controlled at the entry end, while the forming mill, saw, conveyors, etc., on the discharge end of the furnace are all operated from a control table located adjacent to the mill.

The following tabulation shows the data on motors utilized in the complete unit:

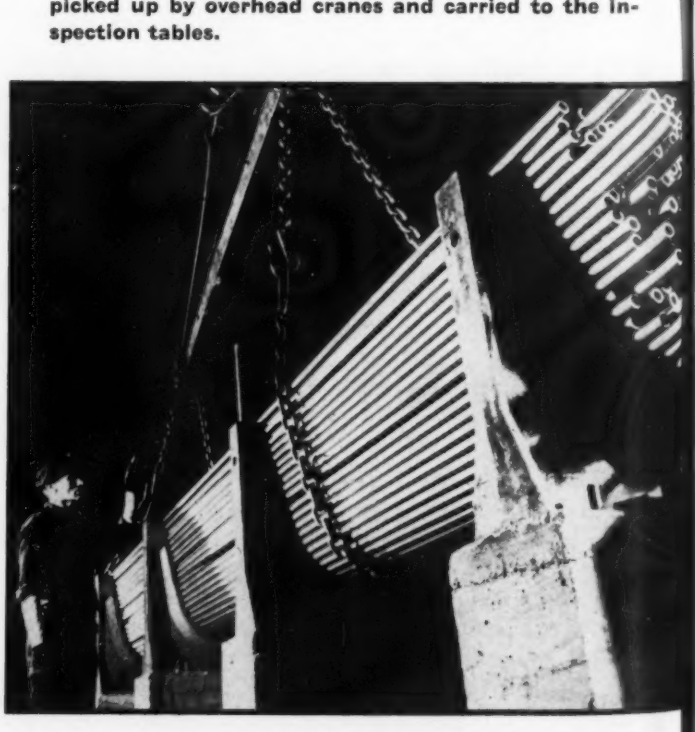
Location of Motor	Hp	Rpm	Voltage
Roller leveler	25	400/1600	230 d-c
Butt welder push-up	5	1200	220 a-c
Flash welder and trimmer	10	870	220 a-c
Combustion air blower	60	1750	220 a-c
Dilution air blowers (3)	22½	1750	220 a-c
Jet blower for edge of skelp	30	3450	220 a-c
Forming mill	15	400/1600	230 d-c
Automatic hot saw	5	3450	220 a-c
Conveyor to small cooling rack	3½	400/1600	230 d-c
Small cooling rack	3½	400/1600	230 d-c
Conveyor to descaler	3	650/1950	230 d-c
Descaler	15	400/1600	230 d-c
Conveyor to cooling table	3½	400/1600	230 d-c
Cooling table	7½	600/1800	230 d-c
Straightener	25	400/1600	230 d-c
Conveyor to tester	3	1150	230 d-c
Total	246.5		

All 18 motors, totalling 246.5 connected hp, together with the 200 kva transformer for the flash welder, represent the total electrical load of the production line proper.

Pipe manufactured by this process has successfully withstood many abusive tests. It has been twisted, crushed, bent, upset, coiled and deformed into every conceivable shape without bursting the weld. Research is being carried out continually and improvements are being studied and incorporated to give even better performance and greater production than has so far been attained.

Important advantages of this method of pipe manufacture are reduced cost of operation and maintenance for a given production, and high quality with high yield.

Figure 11 — After leaving the cooling table, the pipe rolls into a loading cradle. When the cradle is filled it is picked up by overhead cranes and carried to the inspection tables.



Rolling Mill Guides

. . . . setting forth some problems in the design and use of guides, concerning which little or nothing has been published . . . . guide design is not an exact science, but is influenced by varying conditions and requirements . . . .

by Wade F. Hoffman

SUPERINTENDENT, ROLL SHOP

JONES AND LAUGHLIN STEEL CORPORATION

ALIQUIPPA, PENNSYLVANIA

▲ THE first major development in the use of rolling mill guides is said to have been for rolling round bars. Guides were used to hold or support an oval shaped bar, of the proper dimensions, as it entered a round finishing pass in a pair of rolls. This method accomplished in one pass, at higher rolling speeds, what had previously required numerous passes when rolled on the hand mills. Thus the products rolled by these two methods became known as guide rounds and hand rounds. Guides were developed for use in rolling other shaped bars, and mills using guides were often referred to at that time as guide mills. Nearly all present day mills use guides of some description.

It might be well to state the definition of a rolling mill guide. The applicable dictionary definition of a guide is as follows: "Any contrivance, especially one having a directing edge, surface, or channel, for directing the motion of something." This definition seems very suitable if we consider the "something" to be a bar of steel at hot rolling temperature, being directed by a guide into a rolling mill pass and then, by another guide, away from the pass. The guides are termed entering and delivery guides respectively and all rolling mill guides come within these two general classifications. An entering guide is often called an entry guide and a delivery guide is sometimes called a stripper guide, inasmuch as some delivery guides have the end adjacent to the roll in direct contact with the roll pass for the purpose of stripping the bar from the roll, and preventing the end of the bar following around the periphery of the roll, causing what is known as a collar.

Usually, the guides or guide assemblies are supported in proper position near the rolls by members commonly called rest bars, which are placed one on each side of the mill parallel to the rolls and fastened to each housing. The housings customarily have tee slots to accommodate the bolts for fastening the rest bar and permit vertical adjustment. A three-high mill would likely have two rest bars on each side if delivery guides were used for all passes.

The methods for fastening guides to rest bars, and for holding the various parts in position, are numerous, and nearly all methods have some advantages and some disadvantages. For this function, the common wedge certainly performs a prominent part, and many interesting and ingenious applications of wedges or so called wedge bolts have been developed.

The requirements in holding the guides in position vary materially with different equipment, product and personnel. The equipment that seems satisfactory at one plant may prove quite the contrary somewhere else. This condition might well exist in different mills in the same plant.

When rolling flats or slabs with a straight entry and

Presented before A. I. S. E. Rolling Mill Committee Meeting, Pittsburgh, Pa., May 14,'45

delivery, the guides may be of relatively simple design and the materials used and the fixtures for holding them in place may be more interesting and complicated than the guides. This may also be true when rolling some symmetrical shapes in closed passes.

There are circumstances when guides are required to do work on the bar other than simply to direct the front end into or out of a pass. These guides, as well as guides for complicated shapes, often present quite a problem. There are many steel mill engineers and executives who do not realize the extent of the thought and effort that is put into rolling mill guides. This condition probably exists because there are so few men vitally interested or concerned in the details, aside from the rolling crew and the men who design and make the guides. It might be well to state at this time that many of the improvements in guide design are suggested by, or originate with, the men who actually use them. It is amazing what some individuals accomplish in creating guides by the use of grinding, welding and burning. This type of mechanic seems to have replaced, to some extent, the mill blacksmith.

In the earlier times many of the simpler guides, and particularly delivery guides, were forgings made in the immediate vicinity of the mill, usually in the mill building. The forgings for delivery guides were made to suit or fit the actual pass in the roll. This method may still be used, but as the shapes become more complicated it becomes more expensive and impractical. In those earlier times when a casting for a guide was desirable, it was often the practice to take the roll pass templates to the pattern shop with a few general dimensions of the guide in regard to size and fastenings. With this information the pattern maker would make the pattern for the guide. In reality the pattern maker was the guide designer and detailer. Some of these pattern makers became very capable guide men. As time went on it became desirable for various reasons, to make drawings of the guide castings. For complicated shapes or twist guides these drawings are sometimes quite a problem in descriptive geometry. In like manner, reading the drawing and making the pattern often presents interesting problems for the pattern maker. Guide drawings are seldom checked by another individual as it common practice for most engineering problems. To check many guide drawings would almost mean to redraw the problem.

When a moving hot steel bar is in contact with and exerting pressure against a guide, there is sometimes a tendency for particles of the hot bar to adhere to the surface of the guide. This tendency varies with different types of steel and is more pronounced with low carbon open hearth steel. Once such sticking starts, it may build up quickly and cause serious damage to the bars unless remedied. This action in mill language is customarily referred to as "picking up" or "welding." It is usually not a true weld to the guide but is caused by an irregularity in the guide surface and is more of a mechanical bond than a weld. After the pick up has occurred there appears to be, under certain conditions, enough friction heat to weld parts of the bar to the original deposits. The irregularities in the casting may be caused by defects in the original casting or by the manner in which the guide "grooves" or wears. Another source of this trouble is fine cracks caused by heat that appear on the surface of the guide. These cracks are often referred to as fire cracking or heat checking.

Any mark or gouge appearing on a bar during the rolling process that is caused by the guides is called a guide mark or scratch. These scratches may be just visible or may be deep enough to spoil the whole appearance of the bar. In any event scratches are a major problem to mills rolling finished bars.

The term pass, or roll pass, used in reference to rolling, is the surfaces of the top and bottom rolls that contact the bar. The pass may be box type, closed type, or a portion of the surface of plain rolls.

Guides for continuous mills offer many interesting problems and sometimes become a really important part of the rolling process. It is less difficult for continuous mills to justify the effort and expense for guides of unusual character and materials, if by so doing better quality can be effected, or time can be saved by eliminating a few cobbles or by changing passes or by quicker adjustment or replacement of guides. Guides for several types of continuous mills will be described in more detail but many of the remarks, made with continuous mills in mind, will apply to guides for mills in general.

Probably the simplest guides are for single purpose mills, such as sheet bar or skelp mills rolling flats or slabs with a straight delivery from all stands. For the benefit of those who are not familiar with rolling mill guides, detailed description of the guide terms and equipment for this mill will be explained. This type of mill is usually set up to roll a considerable tonnage of one size, except possibly for changes in thickness of the bar. In some cases spare housing units, complete with rolls and guides, are made ready on the mill floor, and for a major size change the housings being used are replaced by those previously made ready. In mills of this type, having rolling schedules requiring infrequent guide changes, simplicity, rigidity and durability become prime considerations in guide design.

The entry guides for this type of mill are usually of a box shape extending from the face of the housing toward and almost into the opening between the top and bottom roll (Figure 1). The inside of the guide near the rolls is customarily the same shape as the bar that will pass through, but enough larger so as to not impede its progress through the guide into the roll pass. Entry guides are in a fixed position and must not touch either roll, as that contact would cause a mark on the roll which would possibly leave an impression on the bar. The shape of the guide varies from the smallest part adjacent to the rolls, flaring toward the face of the housing in what is often called a bellmouth, formed so as to receive the approaching bar and direct it through the guide into the roll pass. In the first or roughing passes where the speed is slow, and the bar heavy and rigid, little trouble is caused by the entry guides, but in the finishing passes the bar may be of light gauge, very flexible and moving at comparatively high speed, so that any hesitation of the bar caused by the entry guide may result in a cobble and associated delays.

These guides may consist of four carbon steel castings. Two of these castings, similar but opposite hand, form the sides. The top and bottom center, or filler, pieces are furnished in various widths. Four through-bolts hold this unit together. The whole assembly is

placed on the rest bar as an entry box, the side castings having provision for bolting to the rest bar.

For some smaller mills, castings called entry side guards are used, and may have the same general shape as the box just described. The top and bottom are cast integral with the sides but separated vertically in the center, causing an opening between the castings (Figure 2). These side guards are fastened to the rest bar in a manner that permits adjustment to accommodate various widths of bar without removing the equipment. Sometimes provision is made to place a cross bar at the top of the guide and against the housing so that part of the thrust caused by the approaching bar is transferred to the housing. The bottom of the guide has a shoulder that fits against the rest bar for the same purpose. If at all possible, this feature is used for all entry guides and most delivery guides, so that any thrust in the direction of rolling caused by the approaching bar is transmitted to the rest bar by direct contact and not by bolts or friction. This is particularly important for entry guides because, if for any reason the end of the bar would not enter a guide, all parts of the guide should be designed strong enough to stop the bar and cause a cobble before any part of the guide would break or come loose and enter between the rolls, the result of which would probably be wrecked or marked rolls.

The edges of thin flats or skelp have a tendency to cut grooves in the sides of the entry guides and this is offset by hard-surfacing the affected areas of the guide, or by designing the casting so that replaceable hard cast alloy inserts may be placed in the proper position to take the wear.

The delivery guides for most mills rolling flats or skelp consist of a top and bottom guide. The bottom guide is like a flat bar, usually somewhat wider than the bar being rolled. It is supported by the roll at one end and by the rest bar at the other, or exit end. A shoulder on the rest bar fits against either the end or an offset on the guide to take the thrust caused by the bar passing along the guide. The end of the guide supported by the roll is curved on the bottom nearly concentric with the circumference of the roll in such a manner that the top edge is in contact with the roll.

The top guide may be a duplicate of the bottom except that near the center of the guide is attached a staple or other means of suspending the guide from above, one end against the top roll, the other end against a fixed bar above the guide. This suspension is generally accomplished by means of a counterweighted lever bar and a connecting rod. On small mills a tension spring is sometimes used.

These delivery guides may be made of forgings, carbon steel castings, and in a few cases, alloy steel castings. The normal wear on these guides occurs at the end of the guide on the surfaces in contact with the roll, and as the guides become shorter they may be adjusted toward the rolls by placing liners at the rest bar end of the guides.

Guides of this type generally have at each side, and fastened to the rest bar, what are known as delivery side guards, which extend from the rest bar to a height above the highest part of the top guide. The end of these side guards nearest the roll are bell-mouthed enough to assure that the bar approaching from the roll pass will be directed into proper position. These side

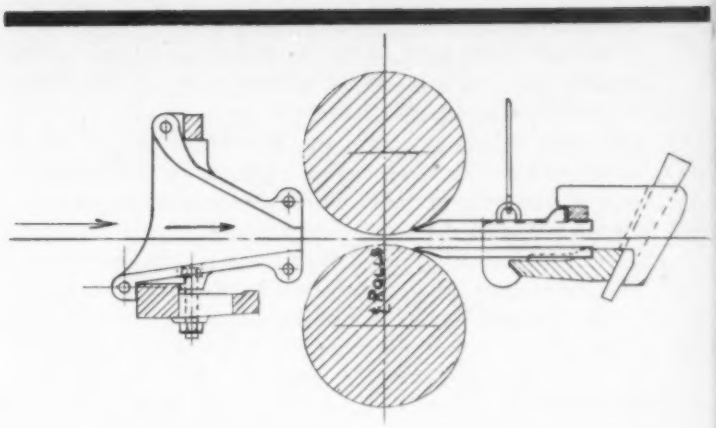


Figure 1 — General setup of entry and delivery guides for skelp mill.

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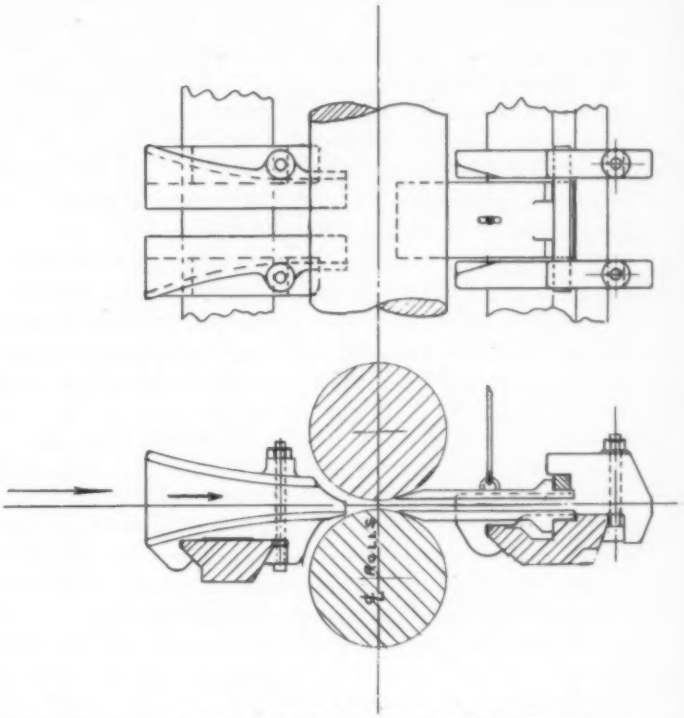
Figure 2 — Typical entry and delivery guides for rolling flats.



guards also provide a means of support for the cross bar against which the top guide is suspended.

The side guards may be an integral part of the rest bar but, for guides of the foregoing description, it is the usual custom to have separate side guards fastened to the rest bar by means of wedges, wedge bolts or, in a few instances, by through bolts so that the side guards can be moved to accommodate various widths of bars.

These side guards sometimes become worn or grooved from the edge of the bar and have to be resurfaced, but excessive wear at this point indicates poor rolling practice, as a straight bar should be delivered by the rolls and not by the side guards when rolling this type of product.

It is sometimes desirable to design a definite breaking point within the delivery guide assembly. If, as the result of some accident, a whole bar or perhaps a whole ingot should pile up between the rest bar and the rolls, the whole delivery guide assembly and rest bar may

otherwise be ruined. To guard against this loss, the size of the bolts used for holding the delivery rest bar to the housing are sometimes small enough to break before the main castings may be distorted.

Several different problems are encountered when rolling square sections, such as billets, on the common type of continuous billet mill having a series of horizontal roll stands placed close enough together to put the bar in several or all of the stands at the same time. The roll passes may be of box type or diamond and square design. In either method, the bar as delivered from every second pass must be twisted by a delivery guide through an angular distance of ninety degrees. This delivery guide is called a twist guide. In this case the guide is designed to cause deformation of the bar, and work is applied to the bar by the guide. When guides are required to do work on a bar, they become a more significant and important part of the rolling process in various phases of operation, design, materials, cost and quality of product.

The entry guides for billet mills accomplish the same purpose as described for skelp mills. They are usually separated vertically through the center and consist of two side guards of opposite hand. When box passes are used for larger billets, 4 in. x 4 in. and larger, the cover part of the side guard is often omitted. This type of side guard may be fastened to the rest bar by wedge bolts, and the guides, customarily steel castings, are not the subject of much attention or trouble.

In the case of the diamond-square method of rolling billets, the entry guides are required to present the diamond shaped bar into the square pass in a very precise manner. The ends of these guides next to the rolls are nearly the same shape as the diamond bar, and the receiving end of the guide has the usual bellmouth shape. These guides are usually separated vertically in the center and may be fastened to the rest bar with wedge bolts. The two halves or sides are fastened together by means of separators and bolts in such a manner as to create a solid connection between the two castings. In this way a means of adjustment is provided. Sometimes these guides are placed in a box-like casting which may be fastened to or be a part of the rest bar. The guides may be held in position within the box by liners, wedges or screws.

These guides are subject to wear, and attention must be given to adjustment and contour. Cast iron is a desirable material. Sometimes alloy cast iron or steel is satisfactory.

The entry guides for directing a square bar into a diamond pass may be similar in design to the guide just described, but with the evident difference in the shape of the inside of the guide. These guides do not require such close adjustment and are not subject to as much wear. For heavier bars, these guides may be in the form of a fore-plate with no cover but with grooves or channels to direct the bar into the pass.

The delivery guides for these mills are customarily in a fixed position and are not in contact with the rolls, but are designed so that the part of the guide adjacent to the bar at the end next to the roll fits very close to, but not touching, the roll. The top and bottom guides are usually identical and have sides that nearly enclose the bar. The bottom guide supports the top guide with provision at the sides for placing liners or fillers to provide adjustment between the guides for different roll settings. A pair of these guides is usually placed in a channel shaped casting sometimes called a delivery guide box. This box has provision in the upper part of the sides for placing a bar called a bridge. Wedges may be driven between the bridge and the top guide so that the guides are held firmly in position. When rolling large size billets, this guide box is usually part of the delivery rest bar which may serve several pass lines and be quite a substantial casting weighing well over a ton. A pair of cast steel delivery guides for a bar of 48 sq in. cross section would perhaps weigh over 800 lb. In contrast, for a small rod mill pass, a pair of cast iron guides, quite similar in purpose and design except for size, might weigh 8 or 10 lb.

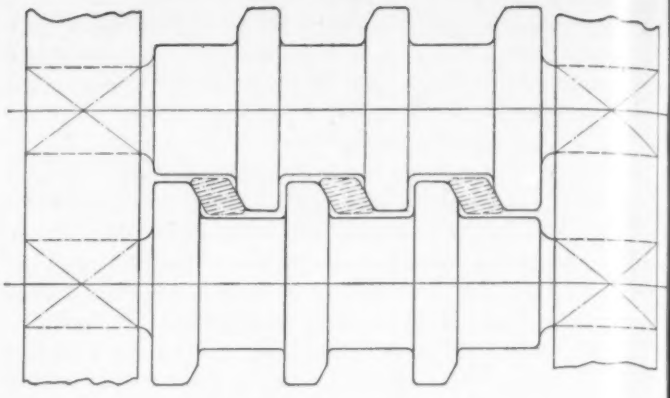


Figure 3 — Grooved horizontal rollers, attached to the delivery rest bar, may be used to impart the desired twist to the piece leaving the mill.

The delivery guides for billet mills are steel castings, and for straight delivery are not subject to much wear and are not much of a maintenance problem.

Delivery twist guides present many problems to the designer, pattern maker, foundryman and mill operator. The conventional design of twist guides is similar in fastenings to the delivery guides just described, and the ends next to the rolls are about the same, but the outline of the inside of the guide at this end immediately starts to revolve about an axis coinciding with a line normal to and passing through the center of the cross section of the bar. This angular change or rotation of the outline of the inside of the guide continues uniformly the full length, so that the angle of twist at the delivery end of the guide is in the same proportion to the total twist required as the length of the guide is to the total distance between the roll stands. Instead of the inside of the guide conforming closely to the outline of the bar, clearance is provided between the bar and the guide at all places except for a bearing surface near the extremities of the cross section of the bar. If a rectangular bar is being considered, the bearing surfaces for the top and bottom guides would be parallel to the long side and placed near the diagonal corners. If a diamong shaped bar were being twisted, the bearing surface for the top and bottom guide would be parallel and on opposite sides of the diamond near the sharp points. It is evident that, for a given section, the greater the distance from the center of rotation to the center of the bearing sur-

face, the less pressure will be required to produce the torque necessary to twist the bar.

This bearing strip is subject to excessive wear and friction. With large billets unusually heavy pressure loads may be encountered, especially when the steel being worked is in the lower range of rolling temperature.

The pressure and friction from the bar along the wearing strip may and often does cause welds to form on the guide. This in turn can cause deep guide scratches on the bar that adversely affect the quality of the product.

For billet mills, the guides are steel castings and it is common practice to resurface the wearing strip with a hard material and grind to a smooth surface. Grinding a twist guide by hand and obtaining anything close to the original contour is not easy, and a method has been developed and used to a limited extent to grind twist guides with a machine tool.

Twist guides for small bars and for rod mills are usually cast iron or heat treated alloy steel castings. Sometimes brass castings are used. These materials are more likely to wear smooth and have less tendency to "pick up."

Many different ideas have been developed for improving or replacing twist guides, but probably none of them are as cheap, easy and economical to maintain as the conventional type just described. However, there are conditions, especially when heavier bars or billets are being rolled, when elaborate and expensive twist guide designs can be justified if a source of scratches can thus be eliminated.

The people of different plants have their own ideas of improved ways of twisting bars and what may seem to be the desirable solution at one place may not be practical at another plant where the conditions and requirements are different. One idea that has been developed for the conventional twist guide is to install for the wearing strip a replaceable insert of hard material. Sometimes these inserts are very difficult to remove at the time they are worn out.

There are many different applications of rollers for twisting the bar. These rollers may be attached to the guide, they may be a separate unit attached to the rest bar, or they may be supported on the mill bed plate close to the guides. These latter units are sometimes called twisters. In one of these methods a pair of rollers is mounted in a cylindrical housing in such a way that adjustment for twist may be made through a worm and wormgear to revolve the housing. In another design there is attached to the delivery rest bar two horizontal rollers, grooved so that as the bar passes between the rollers it is given the required twist (Figure 3). These rollers may be long enough to accommodate several or all the passes in that particular roll stand. Provision is made to adjust the rolls to regulate the amount of twist. This design permits the use of adequate size bearings which are in an accessible position and which are further away than normal from the heat, water and scale of the rolling operation. This is a distinct advantage. For most other type roller twist guides, one of the difficult items of design and maintenance is the bearings, as space is usually not available for adequate size bearings and for the proper protection from the ever present heat, scale and water.

Another design has a roller mounted at the proper twist angle on the end of both the top and the bottom twist guide (Figure 4). This roller may be in the form of a hollow cylinder which revolves about a fixed axle. Synthetic resin fabric bearings, lubricated by service water under pressure, have been found very desirable for these rollers. This water also functions as cooling water for the rollers. No close fits are required, and bearings or rollers can be readily changed by the mill crew. This design permits use of hard nonmachinable alloy castings for rollers, as the straight outside diameter and bore can be ground and the sides can be surface ground.

For all the roller twist guides just described, there is, in some form, a pair of conventional twist guides installed between the roll pass and the rollers to direct the front end of the bar into the opening between the rollers, and as soon as the bar is in contact with the rollers, contact between the bar and the guide is removed. All of the rollers are friction driven and this must be kept

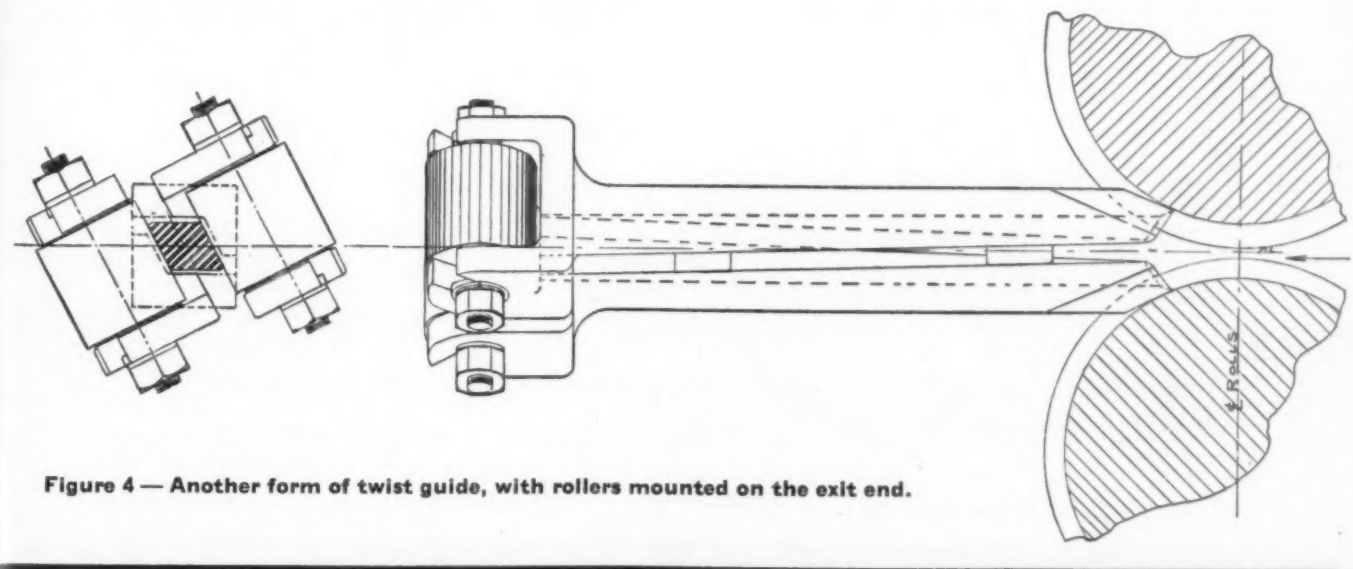


Figure 4 — Another form of twist guide, with rollers mounted on the exit end.

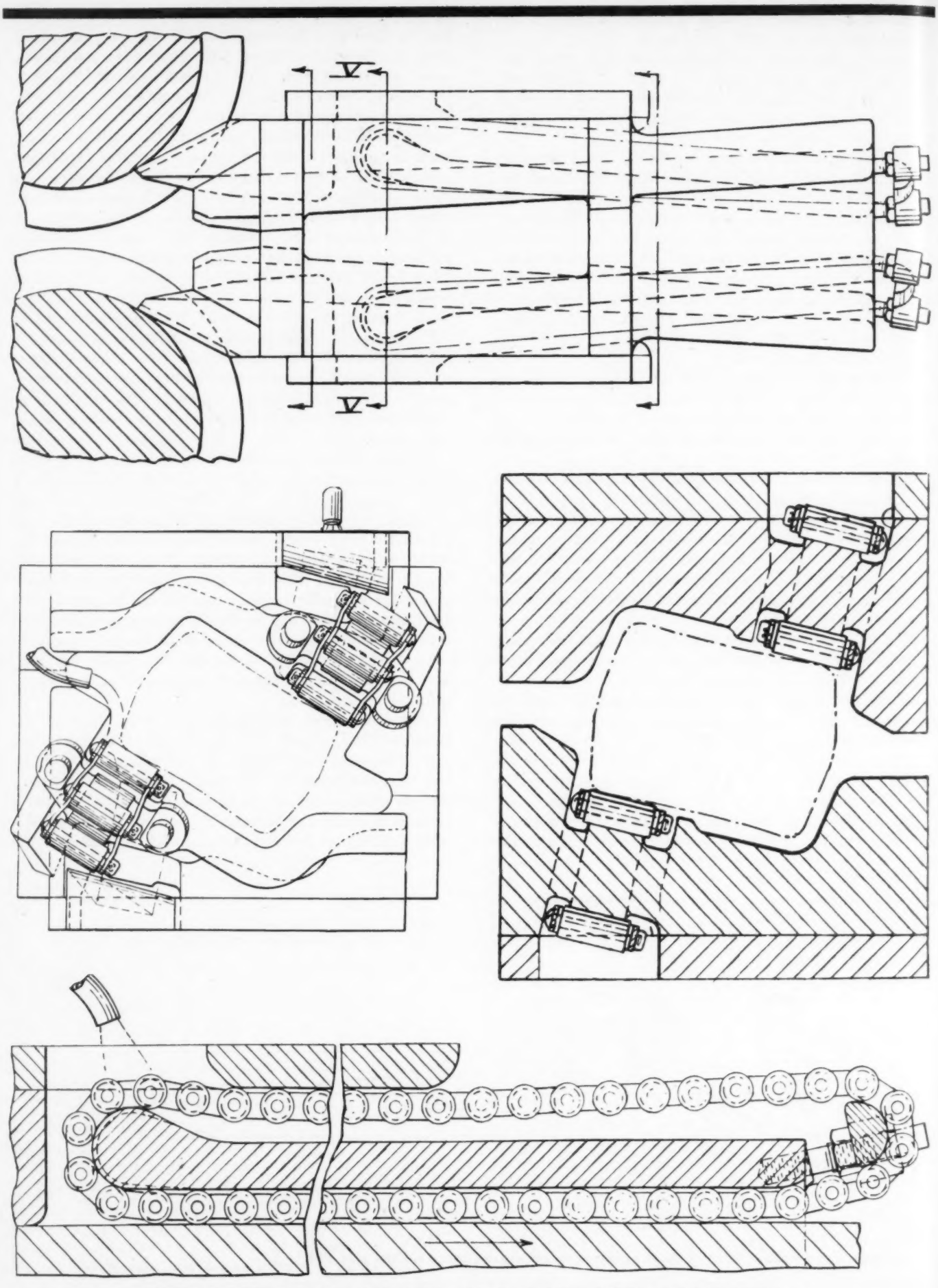


Figure 5 — Patented roller chain twist guide for twisting billets up to 6 in. square.

in mind when selecting bearings so as to provide easy starting.

For twisting larger billets up to 6 in. square, there has been developed a roller chain twist guide (Figure 5). This guide is of the general design of a conventional twist guide, with the greater portion of the wearing strip replaced by a series of small rollers, closely spaced and connected to each other by pins and links to form a continuous chain. These rollers roll along a trough in such a manner that the top of the rollers form a contour similar to the wearing strip of a conventional twist guide. The chain passes around the delivery end of the guide over a tightening device and extends back toward the entry end of the guide, then passes through a hole and enters the trough again. The end of the guide next to the rolls is similar to a regular twist guide for the first 6 or 8 in. As the front end of the billet travels past this part of the guide, the pressure necessary to twist the bar is placed upon the rollers and distributed along the 30 in. length of the roller trough. The load is applied on these rollers in direct compression in a manner somewhat similar to the way the load is applied to the rollers in a roller bearing.

A major problem concerning the operation of many continuous billet mills rolling steel direct from a blooming mill is the delay caused by the frequency of size changes. This condition makes it desirable to have the roll passes and guides arranged in such a manner that many of the popular sizes may be rolled without changing any rolls or guides. Usually this arrangement is obtained only at the sacrifice of roll life, because the roll passes must be far enough apart to allow space between the passes for the sides of guide enclosures or boxes. One way to reduce this requirement to a minimum is to have these guide enclosures integral with the rest bar, maintaining fixed pass locations in the roll. Of course, if size changes are infrequent or if there is enough change time available, the guide boxes may be fastened to and moved horizontally the full length of the rest bar to accommodate roll passes anywhere along the roll. This would make it possible to use more passes, thus reducing roll costs.

The whole situation concerning guide equipment and roll pass arrangement required to produce the various sizes in the most economical manner with a minimum of delays and equipment expenditures is a problem for continual study and must be revised occasionally to meet the ever changing production requirements.

For a continuous merchant bar mill rolling finished flats, structural and special shapes, the guide equipment becomes a real problem and a sizable investment, for nearly every different section necessitates some special guide equipment. Even guides used for rolling flats may call for more than casual attention due to the demand for finished bars free from guide scratches. A glance at a typical rolling schedule for flats would explain why it is not difficult to justify elaborate equipment for making size changes quickly and accurately. It is not unusual for this type of mill to roll twenty to thirty different sizes of flats in eight hours. Several years ago this was forty to fifty changes in eight hours.

The guide equipment for flats may be very similar to

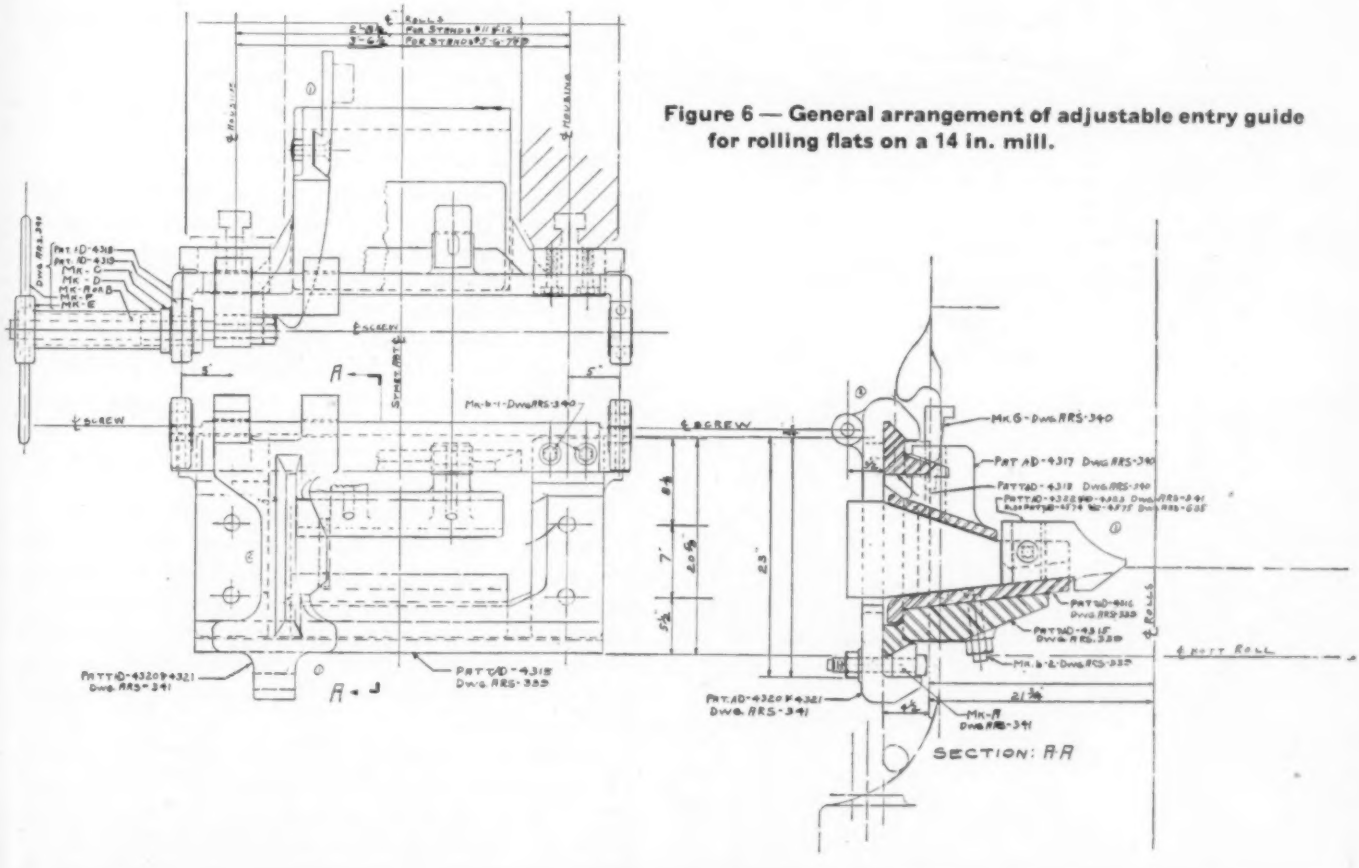


Figure 6 — General arrangement of adjustable entry guide for rolling flats on a 14 in. mill.

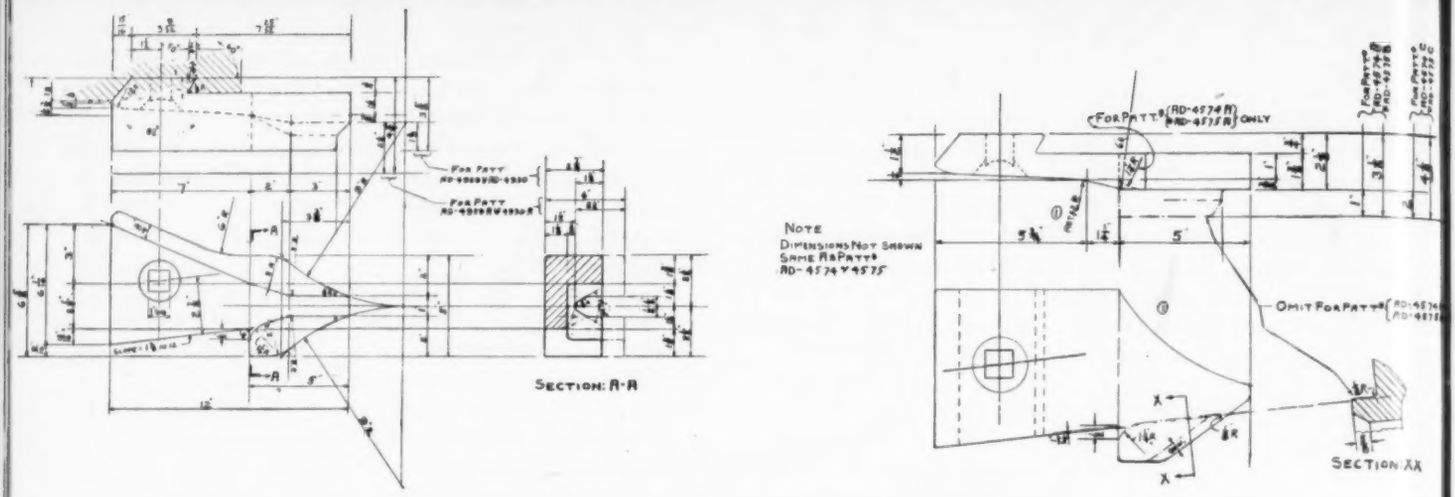
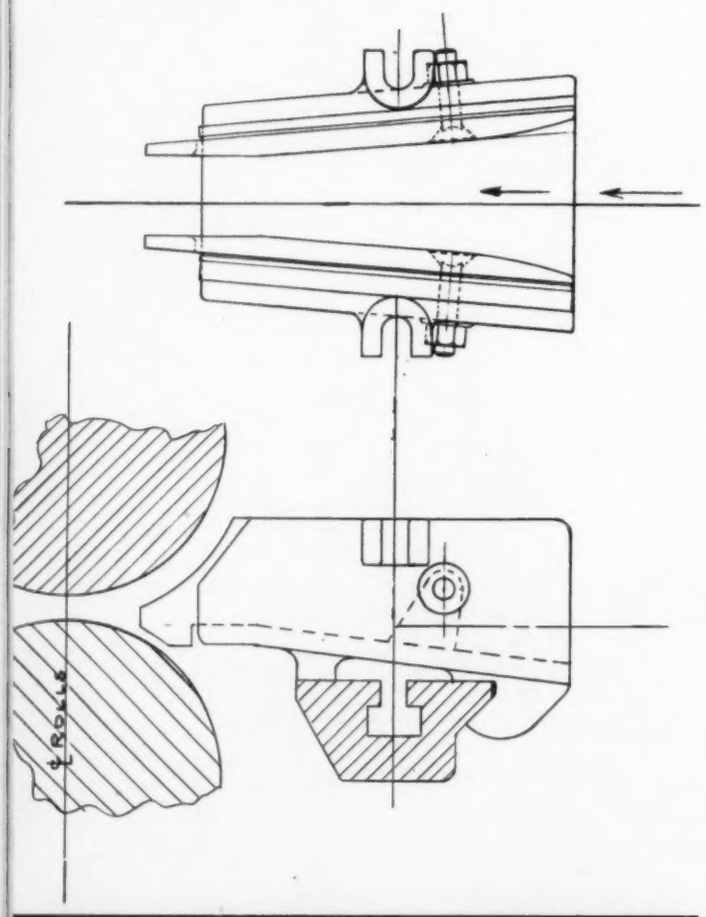


Figure 7 — Details of wearing side plates for adjustable entry guide shown in Figure 6.

that heretofore described for skelp mills, but there have been many ideas developed for entry guides permitting quick adjustment. These are often referred to as adjustable entry guides although, strictly speaking, nearly all entry guides used for flats are to some extent adjustable.

A more elaborate so-called adjustable guide has been developed for this type of mill in which, after loosening one wedge bolt, positive horizontal adjustment of the side guard may be obtained through a nut and screw arrangement operated by a hand wheel at the side of the housing (Figure 6). This adjustment can be made very quickly, and if desirable, adjustments can be made when a bar is passing through the mill without interruption to rolling. The wearing plates on the side guards can be replaced in about three minutes. When this guide was being developed, one of the puzzling problems was designing these wearing plates so that they would be held rigidly in place, and be small enough to handle and permit quick replacement. After arriving at a satisfactory design (Figure 7), the plate was such an awkward shape to lay out and machine, especially in regard to the fits where it was attached to the side guard, that the design did not seem practical. This problem was placed before a manufacturer who had solved some unusual problems in regard to castings and materials for seamless tube mill equipment, such as high mill plugs and reeler shoes. It was suggested that, with special attention in the foundry, these side plates could be cast close enough to dimensions to meet the requirements. As these castings weighed only 15-25 lb and would require no machining, it would be a good opportunity to try hard heat treated alloy castings for guides on a mill of this type. These suggestions, both as to the accuracy of the castings and the use of the hard alloy castings proved quite satisfactory.

Figure 8 — Entry box guide (without top) with removable side wearing plates.



The result of this experiment and the ensuing development is that there are now many hard alloy cast guides in use, especially for roll stands near the finishing ing end of mills producing various shapes in addition to flats, and guide scratching has been reduced to a minor problem. The higher price per pound for such castings is partly and sometimes completely offset by eliminating machining costs.

Another more simple but popular type of entry guide is a box arrangement without a top, with provisions to place a wearing plate on each side (Figure 8). These plates are simple castings that have a cored hole in about the center to accommodate a carriage bolt for fastening to the side of the box. These plates are avail-

able in several different designs and materials. Adjustment is made quickly by removing or inserting liners of the required thickness. These liners are placed between the side plate and the side of the guide box, and are notched to fit around the bolt, which need not be removed unless a different length bolt is required. This type of box is very rigid and will usually stay in position regardless of mill conditions or accidents. This is a worthwhile feature when rolling shapes on open passes, where the position of entry guides may have a direct effect on the dimensions of the finished bar.

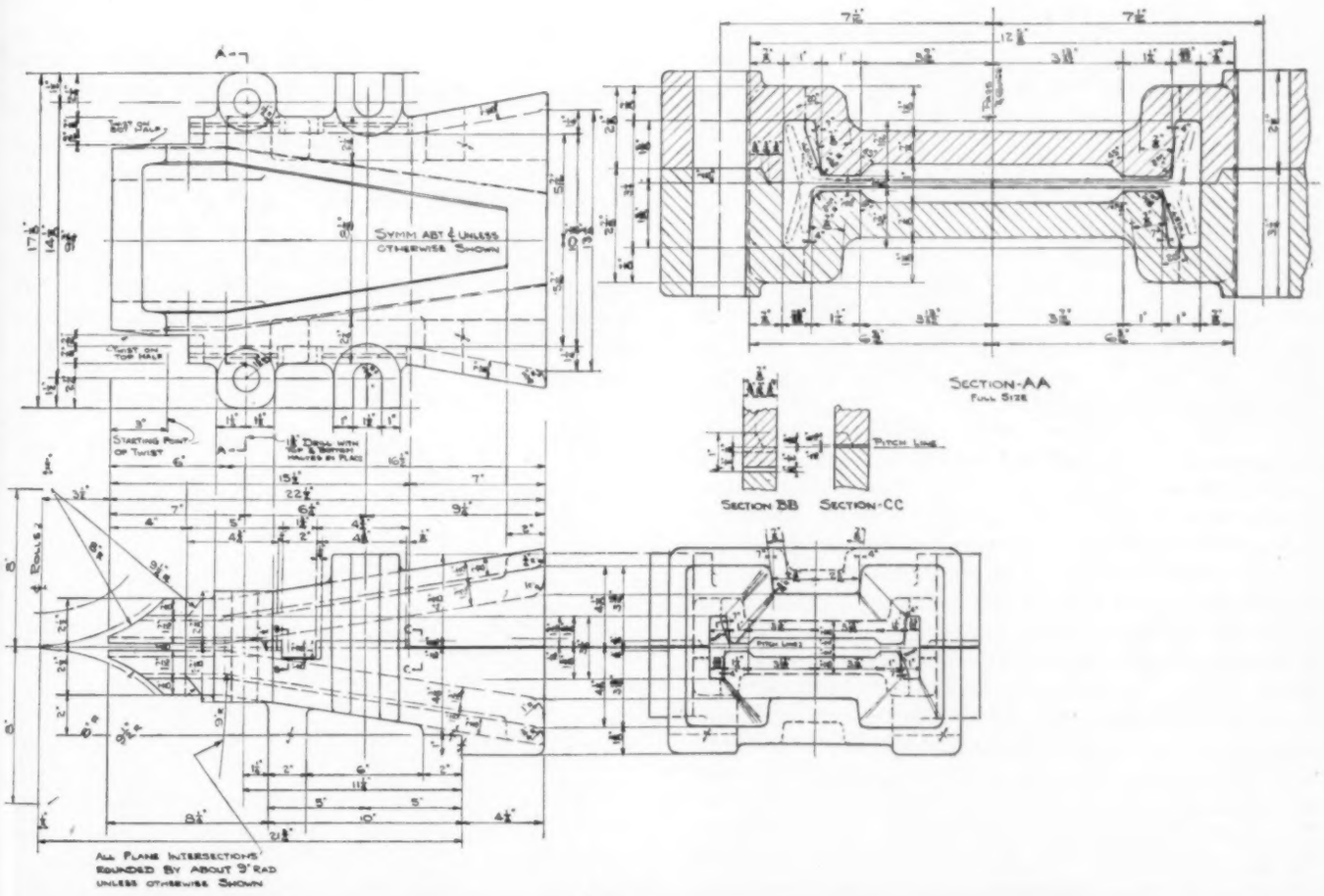
For some special sections it may be necessary to furnish a complete entry box, including a top, for certain passes. For instance, the unusual methods used for rolling extremely light weight beam sections require that the bar be directed into the passes in such a way as to require individual entry boxes with covers for nearly all passes (Figure 9). These guides may be so designed that the bar is directed into the pass by contacting the bar surfaces only between the flanges.

Another instance where it may be necessary to furnish a complete entry box is the entry guide for the finishing pass for rolling structural angles (Figure 10). This guide, sometimes called a shoe or guide shoe, usually contacts the bar on the enclosed angle side and its adjustment may have a direct effect on the appearance or dimension of the finished bar.

Another type of guide, called a screw box entry guide, is used occasionally for special shapes. This box, which is fastened to the rest bar, has a rectangular or square shaped opening. There are set screws installed at both sides and the top, so that a pair of entry guides may be placed in the box and held firmly in position. Small positive adjustments can be made by use of the set screws for either one or both of the guides. The pair of guides may be separated vertically or horizontally. When this style of guide is used on some types of mills rolling finished rounds, hexagons and similar shaped bars, the guides are separated vertically and have a long screw passing through a hole in the mill housing and through a nut fixed in the side of the box, so that the guides may be manually moved closer together after the front end of the bar has entered the roll pass.

Disregarding wear and strength, cast iron is about the best material for entry guides for this type of mill. If cast steel is used, resurfacing critical areas with a hard material is usually necessary. Alloy steel castings are being used with more satisfaction because of the material's high resistance to abrasion and its tendency to take on a smooth polished surface. Some of these alloy castings have a tendency to check or fire crack when exposed to excessive heat. If this cannot be corrected by changing the analysis, it is sometimes necessary to core the castings for water cooling, and it is often desirable to have the cooling water discharge through holes in or near the wearing surface, causing a

Figure 9 — Entering guide box for a 10 in. junior beam, rolled on a 14 in. mill.



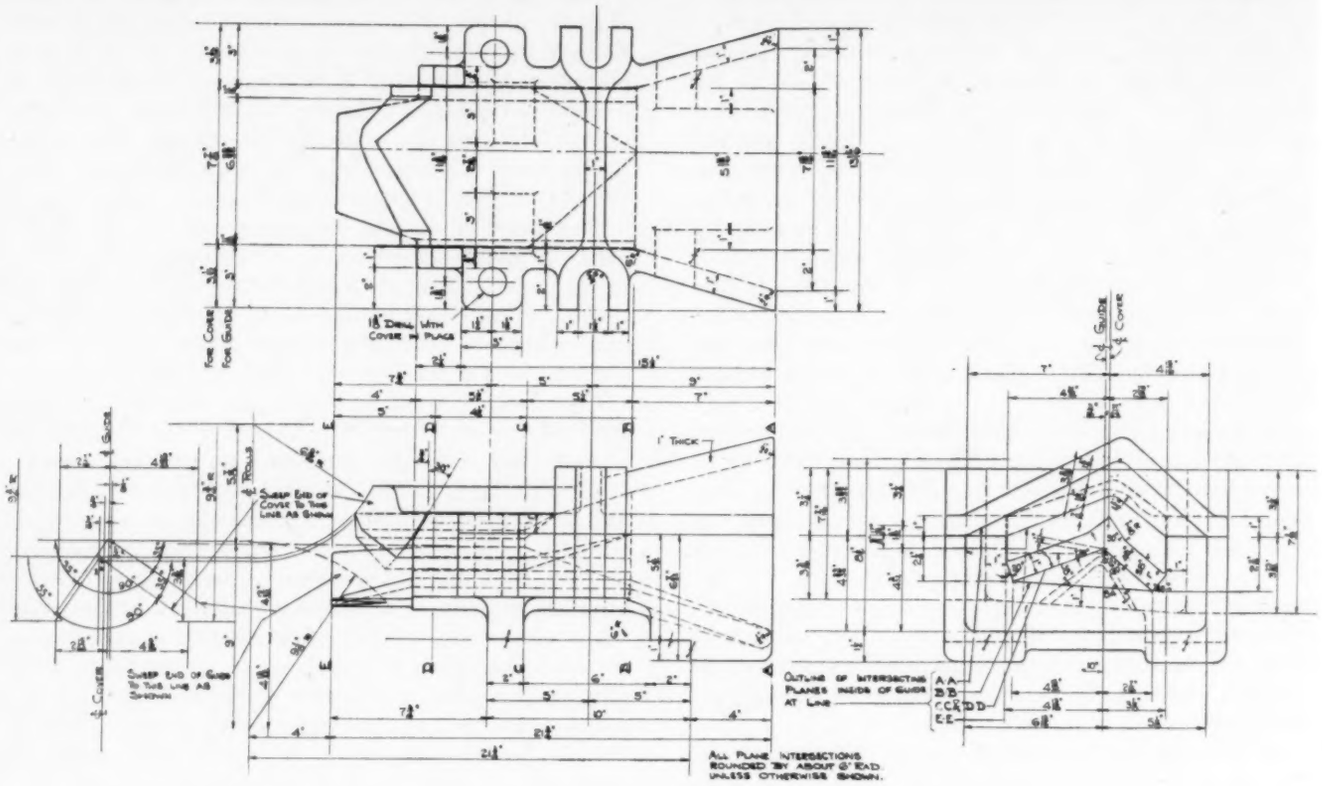
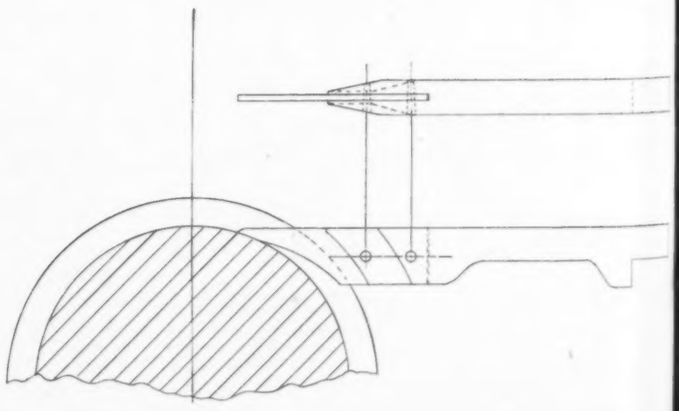


Figure 10 — Finishing entry box for 5 in. x 3½ in. angles, rolled on a 14 in. mill.

flood of water between the bar and the guide. This condition often occurs with vertical edging mill guides that are set close to the bar and thus confine the heat. In such cases surface cooling water is often lacking on the bottom plate.

The delivery guides used for rolling flats on this type of mill are almost identical to the guides used for skelp mills. Delivery guides for shapes are as simple or as odd as the passes for which they are used. The side of the guide adjacent to the bar is approximately the shape of the pass. In any case, the guide must allow clearance for the bar to pass along without any interference. In nearly all cases, the one end of the guide bears on the roll. The guide arrangement for one roll may consist of one or more unattached pieces, with the ends of each piece bearing on the roll and the rest bar, and all pieces placed between the side guards. Roll passes for shapes having thin flanges, such as light weight structural channels or beams, require special attention. The ordinary practice is to have separate narrow guides for the flanges placed beside the larger guide for the remainder of the bar. It is customary to make these flange guides of steel forgings because the end of the guide in the flange of the roll pass may be quite thin. Sometimes these thin points are replaced by a flat rolled steel blade about eight or ten inches long and the required thickness (Figure 11). These blades fit into a slot in the end of the guide and are held in position by two tapered pins driven through holes drilled and reamed through the guide and plate. The pins may be broken off flush with the side of the guide, causing no interference. This blade can be easily replaced when necessary. Multiple piece guides are sometimes simpler and usually easier to fit to the roll when all parts are the correct length, but there is the disadvantage caused by the irregular lengths that occur because of wear. The one-piece guide, although usually more difficult to design and fit, is often preferred. Sometimes the multiple piece guides are welded together to form one unit. This welding method can be used to advantage if there are several shape passes which are similar but enough different in shape to require different guides. Often, castings for several parts of a guide furnished for one pass may be used for several other passes if welded in the proper

Figure 11 — Flange stripper guide with replaceable point.



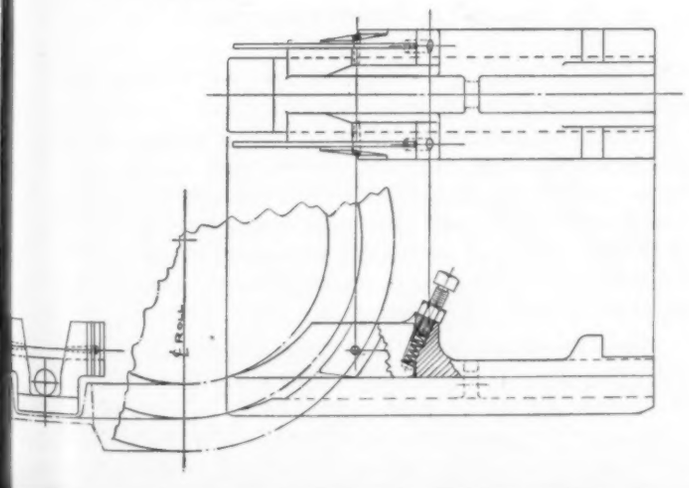
position. Thus, the number of patterns may be reduced and fewer spare castings might be required.

For passes requiring flange guides, one-piece guides may be provided with a slot for a rolled steel blade as described before, and if only one tapered pin located near the center of the blade is used, a limited vertical movement will occur at the one end of the blade, which would permit the guide and blade to contact the respective parts of the roll pass without any fitting (Figure 12). The blade is held in contact with the roll by a small compression spring which fits into a notch in the other end of the blade. This spring fits in a hole in the guide, part of which has been tapped to accommodate a set screw for confining and adjusting the spring. This type of guide has proven quite practical. It was made from carbon steel castings involving considerable machine work until it was suggested that these castings also could be made of hard alloy steel with accurately cored slots. These slots are about ½ in. wide, 3 in. through, and 4-6 in. long. If a thinner blade is used, a filler plate is inserted beside the blade. Many of these guides are now furnished, of carbon or alloy steel as desired, cast to size and requiring no machining except drilling.

Heat treated alloy steel delivery guides will wear many times longer than carbon steel castings and also have the advantage of less tendency to scratch and pick up. There are two common hazards in connection with the use of hard alloy delivery guides. One is breakage, but for normal use this can be overcome by applying the correct material for the work to be done. In case of a wreck, one can be almost certain that the guides will not bend but will come out in pieces. The other hazard is encountering hard spots (sometimes called "cold shots") in the thin part of the guide that bears on the roll pass. These hard spots are not encountered often and may be quite small, but if present, are likely to damage the surface of the roll and cause a roll mark to appear on the bar. If discovered in time, the spot can usually be removed by grinding before much damage is done. The solution to this problem is for the foundryman to furnish castings free from these spots.

An interesting delivery guide was developed for use when rolling "Jaltruss," which is a truss bar shaped similar to a small I-beam with stubby flanges. The web is not solid but in the design of continuous open trusses. During the rolling process, after proper preparation, the bar is spread to the desired width by this delivery guide — an important step in rolling this section.

Figure 12 — One-piece delivery guide with replaceable flange points.



It has not been the intention of this paper to state how mill guides should or should not be made and used, but an effort has been made to designate the use and purpose of guides, and to state some of the problems that are commonly encountered. Guide designing is not an exact science, and the conditions and requirements to be met and overcome are influenced by many variable circumstances. It might be said that guide designing is primarily the development of the ideas of a few people who design, furnish and use rolling mill guides.

DISCUSSION

PRESENTED BY

J. TRANTIN, JR., President, Youngstown Alloy Casting Corporation, Youngstown, Ohio

J. Trantin, Jr.: Mr. Hoffman has given a very comprehensive discussion of the ramifications of designs of guides accepted for rolling various shapes. However, completion of the correct mechanical design of a guide for rolling a particular section does not necessarily mean that all the evils have been eliminated, as a great many of you will attest. The next phase which is also of vital importance is that of the selection of the material from which the guide is to be made, so as to first, minimize scratching of the bar due to "pickup," and second, to secure long life, thereby obviating the necessity of making frequent changes; both of these factors are essential by the operators in securing increased production, lower costs and improved yield.

The selection of the proper guide material becomes the problem of the metallurgist. In order to make an intelligent designation, such variables as rolling temperatures, speeds, analysis of steel to be rolled, pressures and other pertinent facts must be known.

Through the invitation of Mr. Hoffman and the cooperation of his staff we were able to run tests and ultimately develop and make refinements in guide metals. It was demonstrated that the substitution of simple and high alloy steel guides for cast iron, chilled iron and carbon steel proved advantageous from the standpoint of longer life and freedom from scratching, particularly in the finishing passes. Although we showed marked improvements in performance on all the stands, it was found that a carbon steel or low alloy content guide was the most economical in the initial passes. However, as stated before, the greatest savings were effected in the finishing passes.

Results of continued trial proved that the elements chromium, molybdenum, nickel, vanadium and cobalt in the proper proportions showed greatest promise in producing a base steel possessing the desired characteristics required for proper functioning of the guides.

It might be added that all was not roses and we did experience some discouraging results during the process

(*Please turn to page 86*)

Rototrol Regulating Systems

. . . . rotating control has previously produced improved performance with no change in main apparatus . . . . this paper explains principles of the equipment and describes a number of applications . . . .

by A. W. Kimball, MANAGER

ROTOTROL SECTION, MOTOR ENGINEERING DEPARTMENT

WESTINGHOUSE ELECTRIC CORPORATION

EAST PITTSBURGH, PENNSYLVANIA

▲ THE industrial progress made in recent years is a matter of rather common knowledge. The refinement of existing processes, the development of new products, the speeding up of operations, and similar advances have been accomplished in many instances through the co-operation of the individual manufacturer and those who supply his processing equipment. The steel products of today are thus greatly improved, produced faster, and at a lower cost than was possible twenty years ago. This advance has been made possible, insofar as the electrical equipment is concerned, by the steel companies presenting their problems to the electrical manufacturers and working out the solution together. Very often the solution of the problem results in the development of a new principle.

To illustrate this, I would like to cite the development of electrical equipment in the passenger elevator field. I use this field because it is the one in which the first major application of rototrol was made. This started with the application of a direct-current motor operated from a constant potential source, and controlled by varying a resistance in series with the armature. At some later date, adoption of the system known as variable voltage gave materially improved performance. Present day refinements, such as automatic floor landing, and higher operating speeds, with controlled acceleration, required greater fidelity to the ideal than could be obtained economically with the old system. It was therefore necessary to develop a new principle of control. Basically, this employed a direct-current generator of such design that with its associated circuits it could control the system in the manner required.

Machines of this type, with the accompanying control, manufactured by Westinghouse, are called rototrols. The name was coined by the use of the first and last portions of the two words which describe its function, namely rotating and control.

PHYSICAL CONSTRUCTION

Figure 1 shows three rototrol motor-generator sets mounted in a cabinet. These are of the unit frame type construction. The a-c motor and rototrol generator are on a common shaft supported on bearings at the ends. Note that all connections are made through the plug board mounted on top. This permits quick replacement of the set, and is of particular advantage when several duplicate units are used in an installation, and a complete set is carried as a spare.

The rototrol generator is usually supplied as part of a motor generator set. It may replace an exciter required in the previous type of control in which case no added equipment is needed. Structurally it is of the standard industrial type and requires no other maintenance than that normally given steel mill equipment. Spare parts

Presented before A. I. S. E. Cleveland District Section Meeting, January 15, 1945, and Youngstown, January 16, 1945.

such as bearings, brushes, and brushholders can be carried in stock and in many cases will be the same as like parts used in other equipment in the mill. The armature is of the same type of construction and winding as might be found in any exciter of equal capacity now in use. The same is usually true of the frame, poles, air gaps, brackets, bearings, and brush rigging. In some few cases the application may require the use of special treatments or materials in the frame or poles. The fundamental construction, however, remains essentially the same. A 4-pole design with four brush rods, which gives two brush arms per polarity, is now used. The essential difference between it and standard machines lies in the main field winding which consists of a number of coils on each pole. These are insulated from each other, but are usually assembled together and insulated from ground as a unit.

TUNED SELF EXCITATION CIRCUIT

Rototrol systems usually take energy from the output element to be controlled and introduce it into the rototrol generator in such a fashion that the required fidelity to a predetermined performance is maintained. For example, if we have a rototrol exciting a generator and wish to control the generator output voltage, we would excite a field on the rototrol from the generator output voltage to obtain a measure of this element. We call this the introduction of generator voltage intelligence into the rototrol generator.

The output element to be controlled must either be in electrical units of voltage or current or be converted to them. Thus the output voltage of a generator can be used directly as a source of intelligence, whereas speed, not being an electrical unit, must be converted before it can be used in this manner. One such means of conversion is a speed indicating generator.

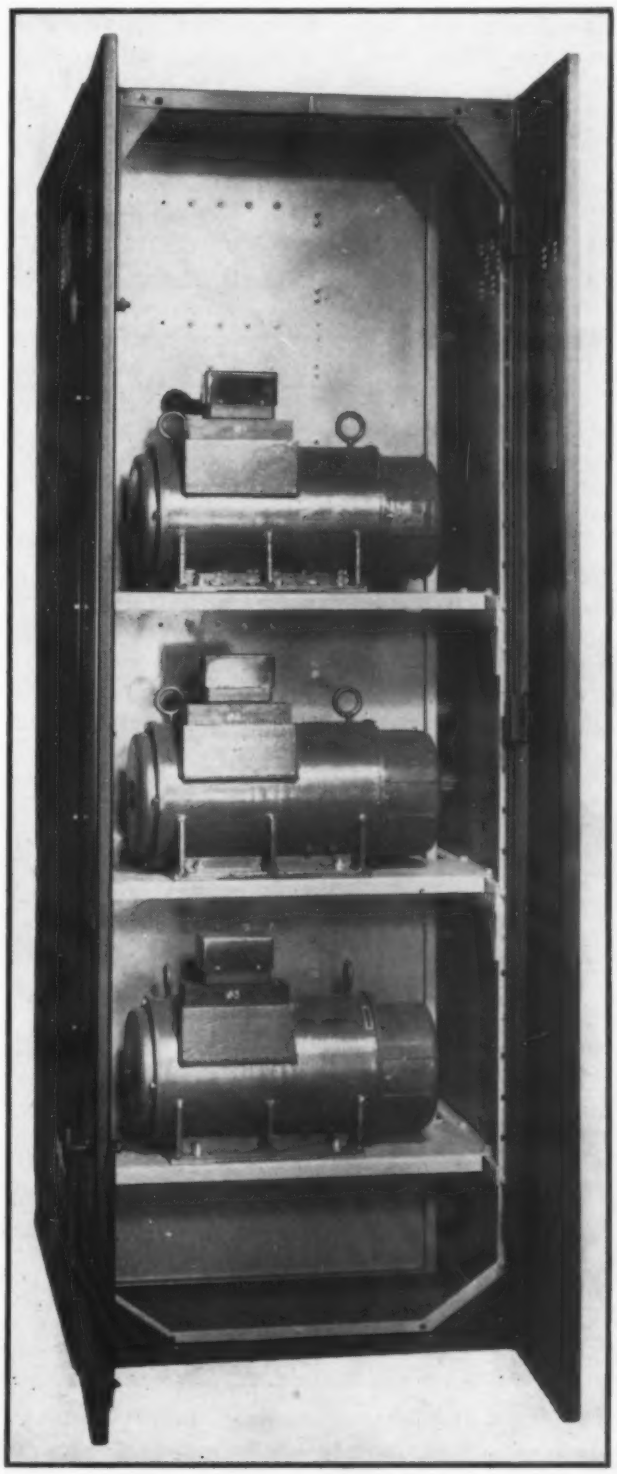
The introduction of energy into the field of a direct-current generator will result in amplification of the energy in proportion to the amplification factor of the machine. This can be greatly increased by the use of additional self-excitation from the output circuit. The maximum amount of self-excitation which can be used without sacrifice of the ability of the controlling intelligence to maintain control of the system is that amount at which it is just self-sustaining. This condition is what we call a balanced or tuned excitation circuit.

FUNDAMENTALS OF OPERATION

The saturation curve of a d-c generator is represented in Figure 2 by the line A-B. It is plotted with output volts as the ordinate and field excitation as the abscissa. The straight portion of the curve shows the field excitation required to send flux across the air gaps. The curves portions at the ends arise from the saturation effects of the iron in the magnetic circuit. In general, rototrol generators are designed to operate on only the straight or air gap portion of the curve. Some uses, however, require operation in the curved portion as well. When this is needed the magnetic circuit is so proportioned as to give the desired curve shape.

The field excitation of the generator can also be shown on this curve. When self-excited it may be represented by a straight line through zero and the slope will be determined by the resistance of the field circuit. This is true because to obtain each value of field excitation, a voltage equal to the current times the circuit resistance is required. A normal shunt wound self-excited d-c generator operating at rated speed and with the field rheostat resistance all in, will have only an output voltage due to its residual magnetism. This condition of field excitation may be represented by a line through zero and lying between the saturation curve and the ordinate axis. As the rheostat resistance is reduced, a point will be reached at which it will build up to about 75 per cent

Figure 1 — Rototrol units in cabinet.



of its rated voltage. This condition may be represented by a line just below the air gap portion of the saturation curve. With further reduction of the rheostat resistance, the output voltage will rise and rated voltage may be set. This field condition may be represented by a line through the rated voltage point on the curve and zero. In rototrol generators, the normal operating range is the air gap portion of the curve. We therefore adjust the self-excitation circuit resistance so that the line representing it is coincident with the air gap portion of the curve. This is shown as line C-D. We call this adjustment balancing or tuning the circuit because the rototrol generator is then capable of supplying itself with the correct excitation for operation at any point on this portion of the curve.

Separate excitation of the field can also be shown on this curve. It may be represented by a line parallel to the ordinate axis since it is a constant value and not affected by the output of the generator. The voltage produced will be that represented by the intersection of such a line and the saturation curve. When separate excitation is added to a generator which has a tuned self-excitation circuit, the combination may be represented on the saturation curve by shifting the self-excitation line along the abscissa. Such a condition is shown by line G-H. The generator will then build up its voltage to the value shown by the intersection of this line and the saturation curve. If the separate excitation had been of the opposite polarity, it would have shifted the self-excitation line to the other side of zero as shown by E-F.

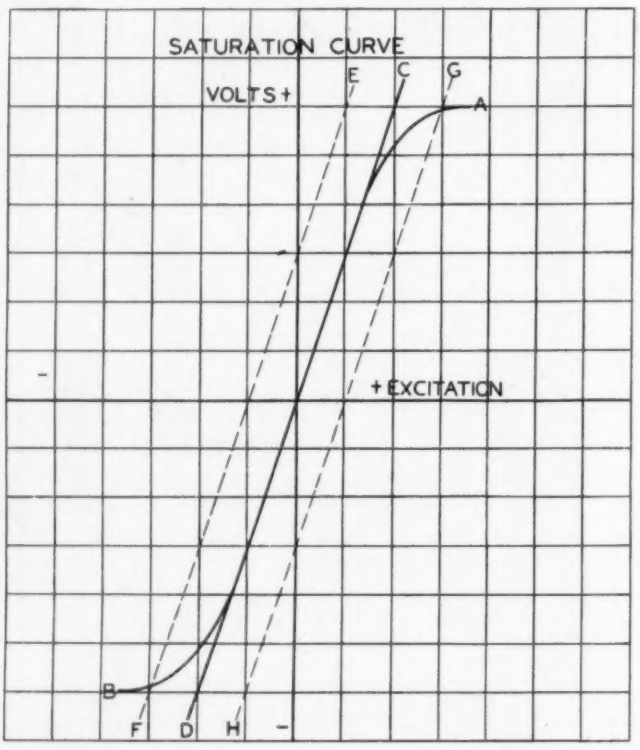
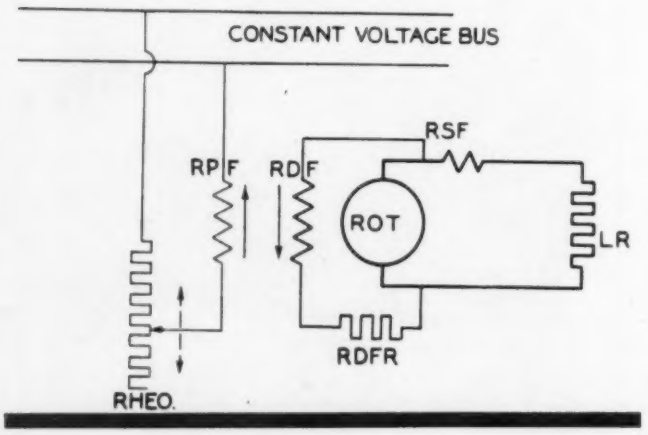


Figure 2 — Saturation curve of d-c generator.

▲

Figure 3 — Fundamental circuit of rototrol.



The manner in which we apply the principle of tuned self-excitation and separate excitation in a rototrol is illustrated in the simple circuit shown in Figure 3. Self-excitation is obtained from field RSF and the circuit is tuned by adjustment of resister LR. It is therefore capable of sustaining its output at any point on the straight portion of the saturation curve. If field RPF is now separately excited it will force the rototrol to quickly build up its voltage to some point on the curved portion of the saturation curve. Since we wish to limit the output to points on the straight line portion of the saturation curve, we must provide some restraining action. This is done by exciting field RDF from the rototrol voltage such that it is differential to RPF and of such strength that when the correct rototrol output is obtained it just equals RPF. Now if the rototrol output is zero and RPF is then excited it will force the rototrol to build up. However, as the output increases RDF is excited and when the correct operating point is reached these two fields neutralize each other. The rototrol operates at this point sustained by its self-excitation field RSF. If the excitation RPF is now removed RDF will rapidly force the rototrol voltage down. However, as it reduces, the strength of both RDF and the self-excitation reduce until zero voltage is reached. At this point there is no excitation, separate or self, so the rototrol voltage stays at zero.

We can now apply this principle as a means of controlling some system by giving RPF intelligence which is the pattern or a measure of the output desired, and RDF intelligence which is the measure of the output obtained. In such a system, when the output is low, field RPF will not be completely neutralized by RDF and the rototrol voltage will be forced up until complete neutralization occurs. Likewise, if the output is high, RDF will more than neutralize RPF and the excess will force the rototrol voltage down until the output is reduced sufficiently that RDF again just neutralizes RPF.

MOTOR SPEED CONTROL

Figure 4 illustrates such a system, and is one which may be used to control the speed of a motor. To keep the diagram as simple as possible, only those parts directly affecting the operation of the control circuit are shown. The motor is driven by the generator and its field MF is excited from a constant voltage source. Its speed is therefore determined by the generator voltage. A speed indicating generator SG whose field SGF is also excited from the constant voltage source is used to give a measure of the speed in electrical units. The generator

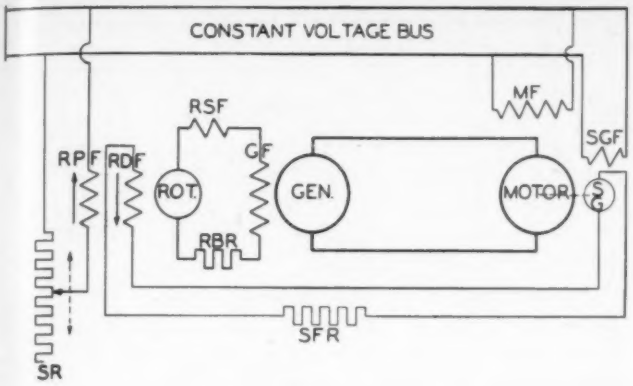


Figure 4 — Circuit for speed regulation.

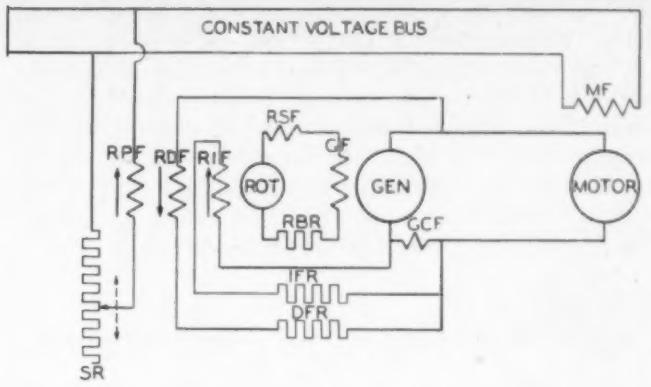


Figure 5 — Circuit for speed regulation without speed indicating generator.

field GF is excited by the rototrol. The rototrol self-excitation is obtained through field RSF and the circuit is tuned by adjusting resistor RBR. Field RDF is excited from the output of the speed indicating generator SG giving a measure of the performance obtained and has a resistor in the circuit to provide adjustment. The field RPF is the pattern field which is excited from the constant voltage source. Variation of the resistance SR provides the means by which the operator obtains the various speeds throughout the range of operation as desired. That is, with the resistance all out a maximum strength of pattern field will be obtained. This requires a maximum speed of the motor in order that the speed indicating generator will circulate sufficient current in the field RDF to neutralize the pattern field. If the pattern field strength with the resistor SR all in, is one-tenth the maximum value, then for this condition one-tenth motor speed will be obtained as this will be sufficient to cause RDF to neutralize the new value of pattern field.

A rototrol system for motor speed regulation without the use of a speed indicating generator is shown in Figure 5. This arrangement is the same as the previous circuit except that the speed indicating generator has been omitted and the motor voltage and current used as the source of intelligence indicating its speed. This is permissible because the speed of a motor, with constant field, is proportional to its counter electromotive force which, in turn, is equal to the applied voltage minus the IR drop. Therefore, if a constant counter electromotive force is to be maintained the voltage applied to the motor must be increased, as the load current increases, by an amount equal to the IR drop. Thus field RDF is now excited by the voltage applied to the motor and adjusted by means of the resistance DFR. At no load the fields RPF and RDF will then control the voltage applied to the motor as determined by the strength of RPF and so control the no-load speed. Compensation for the IR drop through the motor is obtained by the field RIF which is excited from the drop across the generator commutating pole winding GCF and adjusted by means of the resistor IFR. This field being proportional to the load current is therefore a measure of the IR drop in the motor. It is so connected that it adds to the field RPF thereby recalibrating the pattern intelligence as the load changes. The field RDF must now be

Figure 6 — Circuit for speed regulation with current limit.

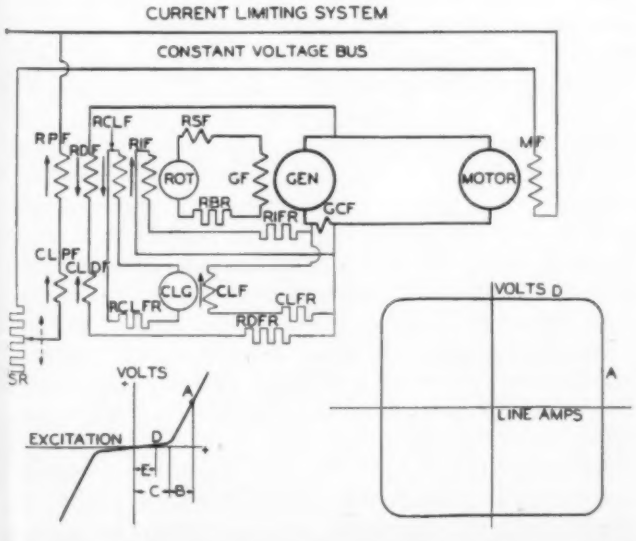
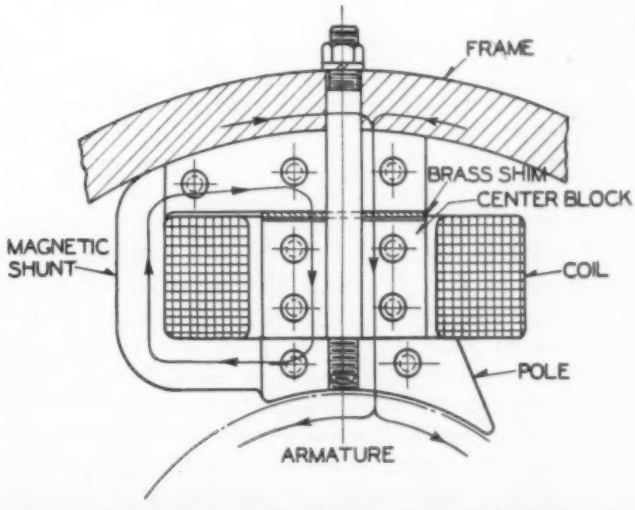


Figure 7 — Current limit generator pole assembly.



increased by an amount equal to the strength of field RIF in order to neutralize the sum of fields RPF and RIF. The magnitude of field RIF must, of course, be in the same proportion to RPF as the IR drop through the motor is to the no-load voltage. This circuit when used with a compensated motor provides essentially flat speed curves throughout the range of operation. It can be made to approximately compensate for armature distortion effects in a non-compensated motor by altering the shape of the rototrol saturation curve.

MOTOR SPEED CONTROL WITH CURRENT LIMIT

Rototrol systems lend themselves readily to the introduction of intelligence from several sources to accomplish a combined result. The one shown in Figure 5 uses generator voltage and motor current intelligence in such a manner as to regulate speed. Figure 6 shows the same arrangement with the addition of the function of limiting the maximum current which can be drawn. This is accomplished by means of an additional unit, the current limit generator CLG and the rototrol field RCLF which it excites.

The current limit generator is of normal 4-pole construction except for the pole pieces and their exciting coils. This construction is shown in Figure 7. The main portion of the pole is in the shape of a horseshoe. The coil is mounted on a center block and assembled into the opening in the pole. The center block is narrower than this opening which provides an air gap at its frame end. This is filled with a non-magnetic material such as brass to provide solid construction. The assembly is mounted in the frame using brass studs. When the coil is excited it will force flux across the center block air gap and through the portion of the pole which forms a magnetic path around the coil. This continues until the magnetic shunt portion at the left is saturated. With further increase of excitation, additional flux will be forced across the center block air gap. However, since the magnetic shunt section of the pole is saturated, this additional flux is forced across the air gap at the armature and returns through another pole of opposite polarity. In this manner a saturation curve as shown in the lower left of Figure 6 is obtained. Excitation C is the point at which the magnetic shunt saturates. Additional excitation such as B will produce an output voltage as shown at A.

The current limit generator receives intelligence through its three fields. Field CLF is excited by the drop across the generator commutating field and has adjusting resistor CLFR in series with it. This gives a measure of the motor load current. Fields CLPF and CLDF are pattern and generator voltage intelligence fields in series with the similar fields on the rototrol.

The operation of this system is the same as Figure 5 except that the rototrol is given the additional intelligence needed to recalibrate the pattern to be followed when the motor armature current reaches the desired maximum value. Assume the pattern and differential fields CLPF and CLDF on the current limit generator were to be made inactive by shorting them out. Then the rototrol would control the generator voltage and produce a volt ampere curve as shown out to the bend.

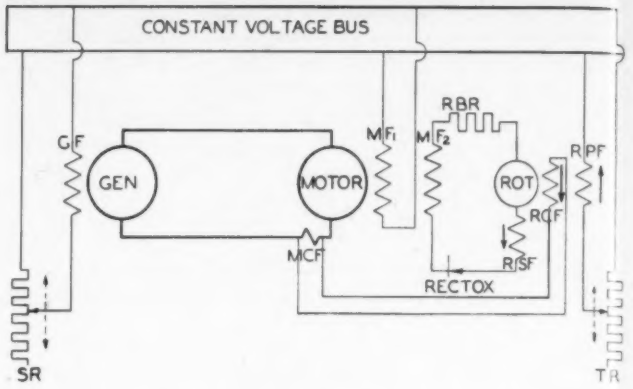
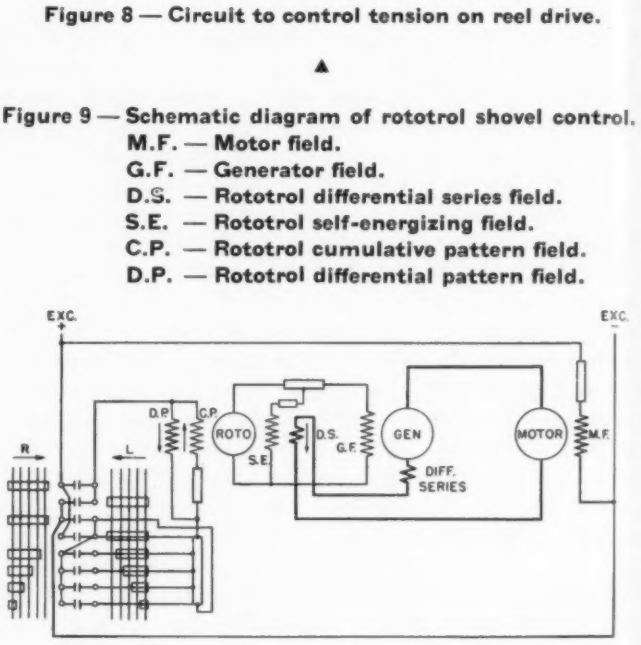


Figure 8 — Circuit to control tension on reel drive.

▲

Figure 9 — Schematic diagram of rototrol shovel control.
M.F. — Motor field.
G.F. — Generator field.
D.S. — Rototrol differential series field.
S.E. — Rototrol self-energizing field.
C.P. — Rototrol cumulative pattern field.
D.P. — Rototrol differential pattern field.



At this point the current limit generator excitation from field CLF would equal the value "C" indicated on the saturation curve. Further increase of motor current would result in field RCLF being excited, causing a reduction in the rototrol pattern intelligence and a corresponding reduction in generator voltage. The volt ampere curve would then have a slope beyond the bend similar to that obtained from a separately excited generator with a differential series field. The addition of pattern and differential fields on the current limit generator removes this slope and produces the true current limit effect from full voltage to zero. At point A the current limit generator output will be as represented by point A on its saturation curve. At point D on the performance curve, the motor is up to speed, the generator at full voltage, and the current limit generator is operating at point D on its saturation curve. Performance on dynamic braking, reversed rotation, and dynamic braking from reversed rotation are shown in the second, third, and fourth quadrants, respectively. Performance at reduced speeds, which are obtained by reduced values of pattern field in the same manner as the previous system, would be represented by a lowering of the whole curve in proportion to the change in pattern field current.

TENSION CONTROL

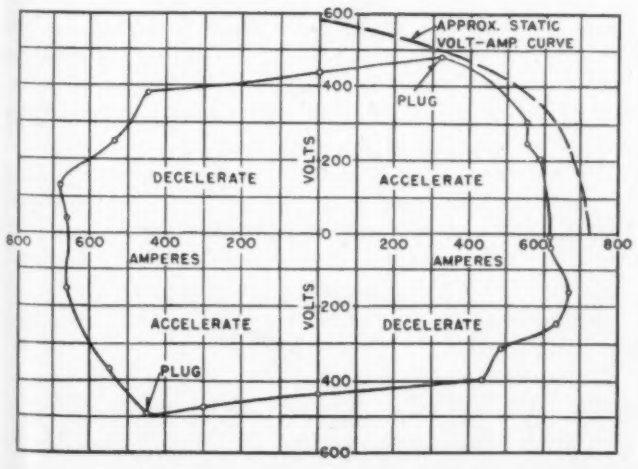
The application of a rototrol to control the tension of a reel drive is shown in Figure 8. The generator supplying power to the motor is controlled by the resistor SR in series with its field GF. The motor field MF1 is excited from a constant potential bus and provides the motor with a field of only sufficient strength to limit its speed to a safe value when operating on maximum voltage. This speed must be greater than any required in the operating range of the equipment. Motor field MF2 is excited by the rototrol. The tuned self-excitation circuit consists of field MF2, the rototrol self-excited field RSF, the rectox, and the adjusting resistor RBR. The rectox is required because weakening the motor field beyond that provided by MF1 would result in a speed greater than the maximum safe speed when operating at maximum voltage. Therefore, MF2 and the rectox must be so connected that the motor field may be strengthened, but any tendency of the rototrol to weaken it is blocked by the rectox.

Constant tension, (disregarding friction losses) can be maintained in a reel drive by holding constant motor armature current when operating on a given input voltage. The rototrol pattern field RPF is excited from the constant voltage bus and its strength is adjusted by the resistance TR. Adjustment of the tension is obtained by varying the value of this resistance. The pattern field RPF tends to build up the rototrol with a polarity such as to cause MF2 to be differential to MF1. Thus when the motor current is low the pattern field exceeds the strength of field RCF and a minimum motor field strength, that of MF1 only, is obtained. This tends to speed the motor up and increase the tension. As the motor current increases RCF increases until it more than neutralizes RPF which reverses the polarity of the rototrol causing it to build up and excite MF2 cumulative to MF1 and reduce the motor speed. When the correct tension is then attained RCF will neutralize RPF and the rototrol will sustain itself through its self-excited field. As the reel builds up the tension tends to increase with consequent motor current increase, but any excess of field RCF over RPF causes the rototrol to increase its voltage, strengthen MF2, slow the motor down, and reduce the tension.

This diagram does not show the recalibration of the tension adjustment required during the acceleration and deceleration portions of the duty cycle. The variation in motor torque required during these periods can be obtained by recalibration of the strength of RPF. The recalibration circuit must, of course, be so arranged that the recalibration is made at the beginning of the action and removed at the end.

Compensation for the change in friction losses as the reel builds up can be obtained by recalibration of the pattern field or by the proper shape of rototrol saturation curve.

Figure 10 — Dynamic volt-ampere characteristics on swing generator rototrol control for dragline.



SHORT CYCLES AND PLUGGING APPLICATIONS

Figure 9 illustrates the use of a rototrol in an application where the operating cycle demands frequent starting and dynamic braking or plugging. This particular diagram was used for a shovel swing motion, but may also be used on blooming mill auxiliaries or similar drives. The rototrol differs from those shown in the previous systems in that at no load on the generator the rototrol is excited by the sum of the pattern and self-excited fields. It is therefore operating at a point above the knee of saturation curve. The iron sections of its magnetic circuit are so proportioned that the desired generator volt-ampere curve is obtained when the rototrol differential series and generator differential series become effective with increasing load currents.

The self-excitation is of the shunt type and so connected as to incorporate an approximate temperature compensation. This is obtained by a proper proportioning of the self-excited field drop to the generator field drop and the resistances. Temperature compensation has also been added to the pattern field. In this case the true pattern field is the difference between the cumulative and differential excitations. Proper choice of relative field strengths and the voltage division across the cumulative portion and its resistor results in approximately constant pattern field over the range of operating temperatures. Another feature of this system is that it incorporates a current limit effect without the use of a current limit generator. This current limiting action is particularly effective on dynamic braking and plugging. The pattern and self excitation fields function in the same manner as the previous systems. The rototrol differential series field DS is the intelligence field which neutralizes the pattern field. Any increase of current beyond this value will cause the rototrol voltage to reduce with a corresponding reduction in generator voltage. The generator differential series field gives an added droop to the regulation curve.

The static and dynamic performance obtained from this system are shown in Figure 10. When this system is plugged, the pattern excitation reverses and the rototrol differential series reverses as the braking current builds up. If there were no other action involved, it would be necessary for the braking current to reach a value twice as high as the limiting motoring current in order to produce sufficient strength in the rototrol differential series field to neutralize the pattern field and supply an equal additional amount so that the rototrol voltage and consequently the generator voltage were

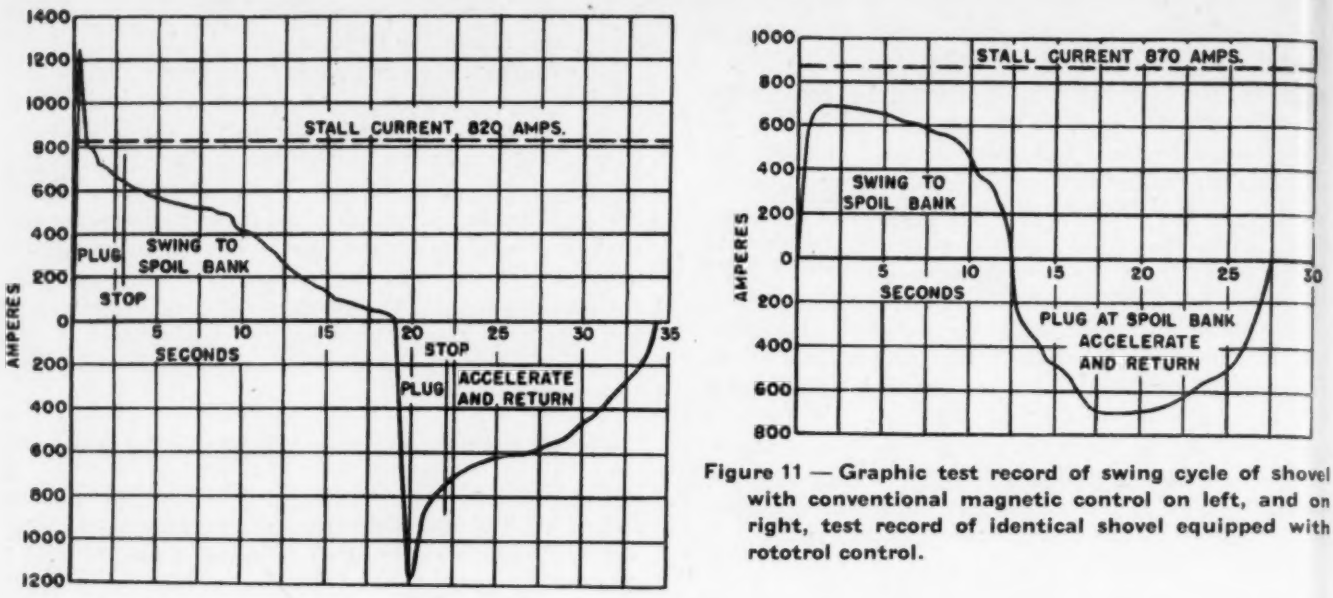


Figure 11 — Graphic test record of swing cycle of shovel with conventional magnetic control on left, and on right, test record of identical shovel equipped with rototrol control.

held up to the no-load value. Actually, it is not necessary to reach quite this value because the IR drop at a given current during braking is in the direction to require less generated voltage in the generator, by double the IR drop, than when motoring at the same current. This condition would result in an excessive peak immediately after plugging. The addition of the series field on the generator, which becomes cumulative during the braking cycle, reduces the voltage required from the rototrol, for the necessary generator excitation, to a point on the air gap portion of the saturation curve. Therefore, the limiting value of braking current required is only that amount needed for the rototrol differential series to neutralize the pattern field. The final results of these actions are shown by the accelerating and decelerating dynamic curves.

A feature of this control is that it produces definite reduction in the area under the decelerating curve as compared to that under the accelerating curve. This is desirable since during acceleration friction must be overcome while on deceleration it aids the braking action.

A comparison of the graphic charts obtained with the conventional magnetic control and with rototrol control are shown in Figure 11. Note that the plugging peaks were reduced from approximately 1200 amperes to 700 amperes and also the time for a complete cycle was reduced from 34 seconds to 27.5 seconds. The reduced current peaks result in lower peak torques and maintenance. The reduced time per complete cycle is a direct time saving for the operation.

To sum up this discussion I have endeavored to demonstrate the fundamental principle of operation and the versatility of the rototrol. The connection diagrams have shown only a few of the types of circuit used. There are many variations of each type as well as other circuits incorporating still other features. The advantage obtained by the use of this type of control is improved performance with no change in the main apparatus. A number of applications have been made where it is used with equipment which has been in service for several years.

The improved performance is accomplished by the use of the machines at or near their capacity during a greater portion of their operating cycle. A second gain is in the reduction of maintenance. This is obtained through the elimination of power peaks with their attendant stresses in the equipment and the replacement of magnetic controls with static circuits. Future developments will, of course, be made to improve the rototrol's abilities. One of these will probably be the elimination of the need for external pattern intelligence. Its use is being continually expanded into new fields and to do more difficult tasks. Its general adoption by industry assures its position as a permanent type of electrical apparatus.

Hoffman DISCUSSION

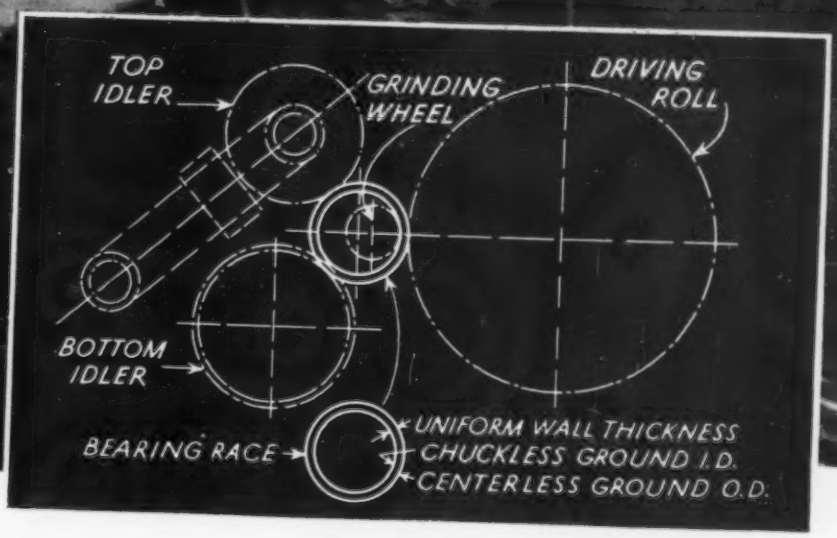
(*Continued from page 79*)

of elimination. On one occasion, the top of the strip mill entry guide isolated itself and took a turn on the strip and introduced itself to a number of passes. However, this was not serious enough to do any great damage other than to become alarming and place the operators in a skeptical and cautious frame of mind. In this instance, the degree of hardness imparted to the guide was too great. In some cases fire cracking developed but did not prove serious, since no difficulty in "building up" scale was experienced. Further application of water in correct places alleviated this condition to a great extent.

In correlating our results of performance of guides on various mills of different characteristics and types of steel rolled, we developed five distinctive types of steels: (1) low chromium, low carbon; (2) high chromium, high carbon; (3) high chromium, high carbon, high molybdenum; (4) high chromium and nickel; (5) high chromium, cobalt.

Our experience during the past few years has taught us that one type of steel guide will not serve as a cure-all, and therefore it was necessary to supply different analyses of guides, properly heat-treated, for specific operations in order to secure proper functioning.

We built the skill of the craftsman into the machine!



If every raceway for a Hyatt Roller Bearing were painstakingly fashioned by expert tool makers they could be no more concentric or of more uniform wall thickness than obtained by our centerless grinding machine production.

First we externally grind by our improved arborless grinding method. Then the perfect outside periphery thus obtained is used as a guide in grinding the inner diameter of outer races, the track upon which the rollers operate.

This new principle invented several years ago by Hyatt Methods and Equipment Engineers we call "Chuckless Grinding." Thus into the machine we built the skill of the craftsman and precision manufacture at a mass production pace was born.

This is just another example of the many exclusive manufacturing processes which enable us to build accuracy, longer life and more dependable performance into Hyatt Roller Bearings for every application.

* * *

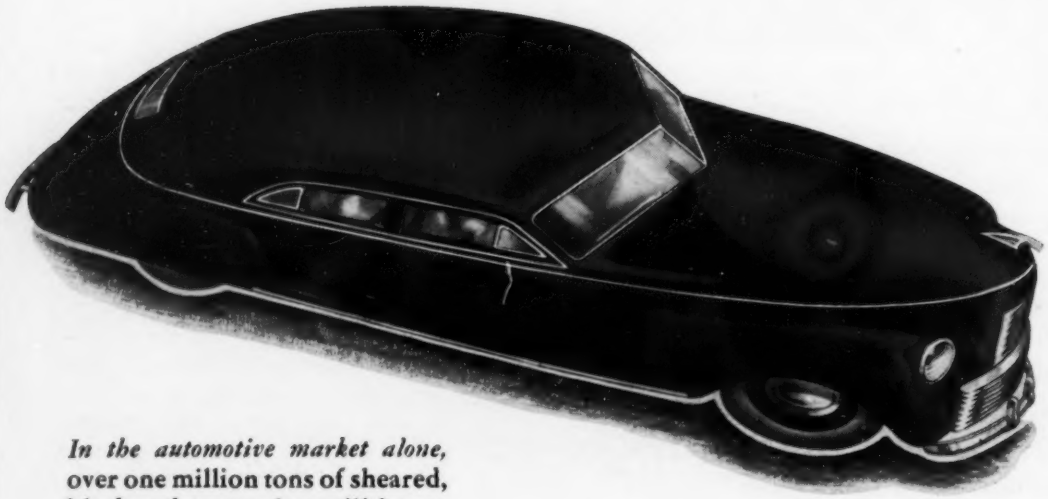
Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

COST will decide the part YOU play in "FORMING THE FUTURE"

In the keen competition that lies ahead, America's Rolling Mills will be presented with an opportunity *and a challenge* that will tax both their capacity and their ingenuity. Hand-in-hand with these opportunities you will see an industrial era which has no room for wastes and inefficiency. Costs will decide your share of the market... and costs will be LOWER in plants where LEWIS ROLLS roll steel at LESS COST PER TON!

LEWIS FOUNDRY & MACHINE
DIVISION OF BLAW-KNOX CO., PITTSBURGH, PA.



In the automotive market alone, over one million tons of sheared, black and terne plate will be required per year for civilian needs.*

**Source—American Iron and Steel Institute*

ARMY E NAVY

Also manufacturers of ROLLING MILL MACHINERY for the iron, steel and non-ferrous industries

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OXWELD HIGH-SPEED NOZZLES CUT STEEL NEARLY 50 PER CENT FASTER THAN STANDARD CUTTING NOZZLES

With OXWELD high-speed oxy-acetylene machine-cutting nozzles, two-inch plate, for example, can be sliced at the rate of one foot per minute—a saving of one-third the time required for cutting with standard nozzles. Six-inch square bars can be cut off in 20 per cent less time than is ordinarily required. Even at these high speeds the cut edges are unusually clean, smooth, and true, and the kerf narrow. "Supersonic velocity" does it—the shape of the cutting oxygen passage makes the oxygen flow faster than the speed of sound. In addition these high-velocity jets make these nozzles less subject to fouling from flying particles of scale or slag.

OXWELD high-speed cutting nozzles are available in five different sizes. Write us for additional information or ask any Linde representative.

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The word "Oxweld" is a registered trade-mark of Union Carbide and Carbon Corporation

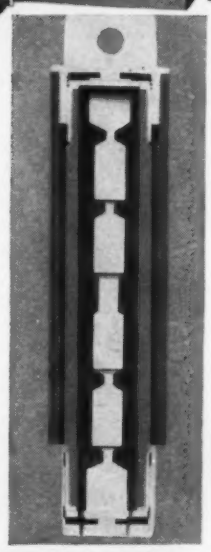
FOR MAXIMUM SAFETY AND CONTINUITY OF SERVICE

Rowan COMPLETELY OIL IMMERSED, FUSED, SAFETY LINE DISCONNECT SWITCHES

Designed and time-tested for locations where the atmosphere is contaminated with corrosive elements, semi-hazardous and hazardous vapors and dust. Continuity of service under these conditions and adverse weather conditions has proved the dependability of these switches far beyond the claims made for them. You will find them located in chemical plants, powder plants, oil refineries, synthetic rubber plants, cement plants, gypsum plants, etc.

They are equipped with the Rowan Air-seal Fuses which have the same characteristics under oil as in air, in addition to inherent increased interrupting capacity.

The disconnect switch is of the quick acting contactor type with renewable contacts.



The Rowan Air-Seal Fuse — introduced by Rowan engineers to provide a low-voltage fuse for use under oil. Cutaway shown at right illustrates unique design. Supplied in 30—60—100—200—400 amp., 250 and 600 Volt.

Other features of the Rowan Oil Immersed Disconnect Switch are:

1—ROWAN AIR-SEAL fuses. **2**—Completely oil immersed. **3**—Disconnect switch of the quick acting contactor type with renewable contacts. **4**—Safety enclosing case mechanically interlocked to prevent lowering of tank when switch is in operating position or closing of switch when tank is lowered. **5**—Enclosing case is weather-resisting and dust-tight. **6**—PROVISION for locking disconnect switch in "off" position. **7**—Tank handles for ease of handling.

The Rowan Controller Company has specialized in Oil Immersed Controls for nearly half a century. Results and performance achieved by users justify the Rowan claim of superiority in this field. Write for complete information on Rowan Oil Immersed Controls.

ROWAN CONTROL

THE ROWAN CONTROLLER CO., BALTIMORE, MD.

ADVANTAGES.. in Design

1. Simple construction
   a. No tapes or braids
   b. No metallic coverings
2. Insulated by Strip Process
   a. Perfectly centered conductors
   b. Uniform thickness of Okolite insulation
   c. Uniform thickness of Okoprene covering
3. Vulcanized in a continuous metal mold
   a. Tough, dense covering
   b. Uniform vulcanization throughout length

ADVANTAGES.. in Operation

ELECTRICAL

Okolite Insulation

1. Ozone resistant
2. High dielectric strength
3. Stable electrical characteristics
4. Low specific inductive capacity
5. High current carrying capacity (75° C copper temperature)

Okoprene Covering

1. Additional dielectric strength
2. High surface resistance eliminates charging current drainage from surface of cable
3. Ozone resistant

PHYSICAL

1. No braids to rot
2. High moisture resistance
3. Resists oil and solvents
4. Resists acids, alkalies and corrosive chemicals
5. Non-flammable covering
6. Can be operated at 75° C
7. Unaffected by sunlight
8. Weatherproof
9. Long-lived

ADVANTAGES.. for Installation

1. No potheads required
2. Easy to splice
3. Light weight
4. Small outside diameter
5. Smooth, snag-proof covering
6. Easy to pull into ducts
7. High abrasion resistance
8. High tensile strength sheath
9. Flexible at low temperatures
10. No saturants to soften in heat or flake off in cold weather
11. Can be bent on small radius

get them all in one cable

OKOLITE-OKOPRENE

Because of its versatility and because of its low maintenance, OKOLITE-OKOPRENE* is an excellent electrical cable for all-around service. Engineers can specify it with confidence in its performance record, as millions of feet have been installed and have proved long-lived under widely differing conditions of operation. Among the fields in which these applications have been found widely useful are the various branches of the metal-producing industries.

Install them in ducts . . . bury them directly in the earth . . . expose them to the elements, Okolite-Okoprene cables need no additional protection. Designed in all standard sizes and many colors for service up to 5000 volts, they are simple to handle, splice and terminate.

The principal advantages of Okolite-Okoprene cables are condensed above. Note that these include the electrical operating advantages of Okolite insulation and Okoprene covering. Bring your problems of electrical distribution to Okonite engineers. Pool your own experience with theirs for the best results in the selection of insulated wires and cables. The Okonite Company, Passaic, New Jersey.

*Patent No. 2,312,058

OKONITE OKONITE SINCE 1878 **insulated wires and cables**

4044

HERE'S WHY MORE THAN 90 PER CENT OF THE NATION'S STEEL MILLS

USE BOWSER LIQUID CONTROL SYSTEMS

There is a mighty sound reason for the predominance of Bowser equipment in the steel industry.

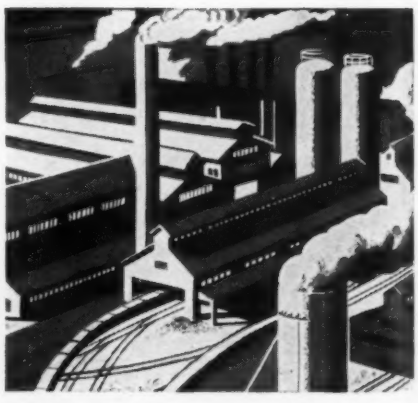
The superior performance of Bowser Liquid Control systems under the most exacting conditions would be reason enough. But the real reason goes back to the fact that Bowser's staff of lubrication engineers know steel mill lubrication "from ore to finished product" and design every particular requirement. Bearing sizes, type and speed of rolling, and conditions of installation are controlling factors in the engineering. The lubrication unit is tailor-made. It becomes an integral part of the mill.

That's why 90 per cent of the steel mills in America are equipped with Bowser systems.

No matter what your liquid control problem may be, chances are Bowser can solve it. Bowser's engineering staff is at your service. Write today for your free copy of "Lubrication Equipment for Rolling Mills." Use handy coupon below.

BOWSER EQUIPMENT FOR STEEL MILLS

Filters • Oilers • Self-Contained Lubricating Systems • Coolant Systems • Lubricators Turbine Oil Conditioners • Central Lubrication Systems.



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BOWSER ESTABLISHED 1885

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Industrial Division, Dept. 13-K
Fort Wayne 2, Indiana

Please send "Lubrication Equipment for Rolling Mills."

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THESE MOTORS THRIVE ON

SA35

WESTINGHOUSE TYPE SK

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IN OUR OPINION, "National" Grade SA35 carbon brushes outperform all other grades on D.C. general purpose and heavy duty motors whether they be in mine, mill, shop or factory—on lathes, pumps, fans—on numerous industrial applications.

This brush, from the very day that it was introduced, has proven more and more dependable chiefly because of its commutating ability, uniformity in brush life and operating economy. For that reason we say—These Motors Thrive . . . On SA35.

Also adapted to heavy duty D.C. generators and rotaries and to reversing and continuous mill drives, grade SA35 is recommended as well for A.C. commutating type single phase and polyphase motors and repulsion-induction motors. Also for welding generators.

If you are not using "National" Grade SA35 on such equipment, we urge you to try it and learn at first hand of its most important feature—its *dependability*.

The word "National" is a registered trade-mark of National Carbon Company, Inc.

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation

UCC

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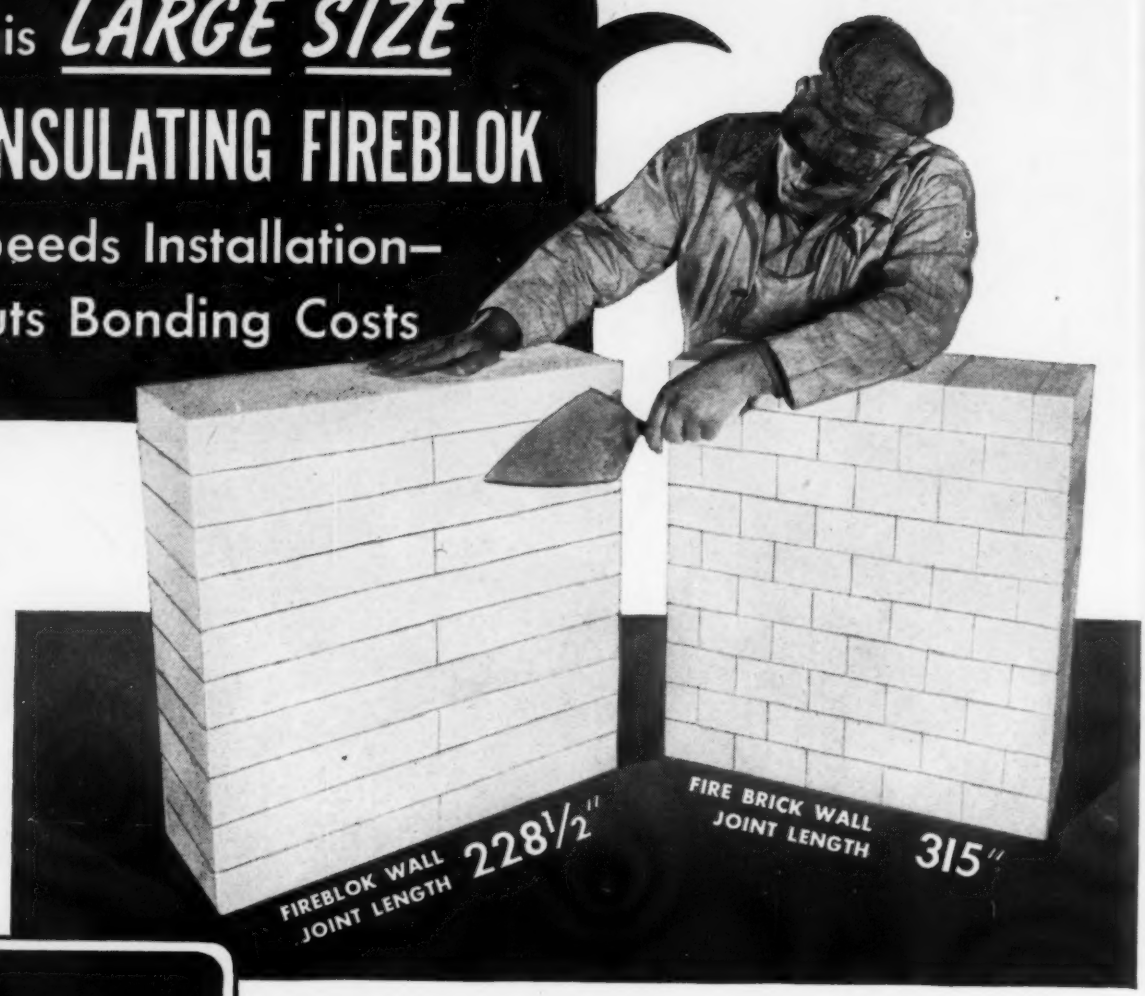
This *LARGE SIZE* J-M INSULATING FIREBLOK

Speeds Installation— Cuts Bonding Costs



Over 5 times as large as ordinary fire brick, Fireblok goes into place quickly and economically. Not only is labor time saved, but costly shut-down time is decreased.

4 Fireblok types available

JM-1620 Fireblok for exposed temp. to 1600° F. As back-up to 2000° F.

JM-20 Fireblok for use up to 2000° F. Exposed or back-up.

JM-23 Fireblok for use up to 2300° F. Exposed or back-up.

JM-26 Fireblok for use up to 2600° F. Exposed or back-up.

THE TWO WALLS shown above are approximately the same size. (The Fireblok wall is 1½" longer.) Yet you will note it takes more than five standard bricks to cover the same area as one J-M Fireblok. And, therefore, the brick wall requires about 40% more bonding.

Save time: One Fireblok can be set more quickly than 5 bricks. This not only reduces labor . . . but cuts furnace down-time to a minimum.

Cut bonding costs: Fewer joints also lower costs by reducing the amount of cement needed for bonding. (J-M 1626 cement was developed especially for this use.)

Fewer joints cut heat loss: The broader, uninterrupted surfaces of J-M Fireblok increase the thermal efficiency of the construction.

Variety of uses: J-M Insulating Fireblok are particularly recommended for industrial furnaces, flues, stacks and similar equipment. Also, for lining doors, suspended arches, and, when tapered, for sprung arches of exceptional stability.

For specific temperature ranges: Like J-M Insulating Fire Brick, Fireblok come in four different types . . . each especially developed for its temperature range.

Easily cut and fitted: Fireblok are easily shaped with saw, drill, and rasp. Can be cut to fit irregular shapes . . . making large stock of special sizes unnecessary.

One of many—Fireblok is only one member of the large J-M industrial insulation family—each perfected through years of research. For details, consult your nearest J-M office or write Johns-Manville, 22 East 40th Street, New York 16, N. Y.

JM

JOHNS-MANVILLE *First in* INSULATIONS

POWER

When electric industrial trucks, powered by Exide-Ironclad Batteries do the lifting, hauling and stacking of materials, you can be certain of *full shift availability* hour after hour, day after day. There is no down time for adjustments, repairs or other attention.

Exide-Ironclad Batteries have the *high power ability* needed to meet the high-kilowatt demands encountered in "stop and go" materials handling. They provide *high maintained voltage* throughout discharge, thus assuring a uniform rate of operations. And the *high capacity* of Exides keeps electric industrial trucks on the job during every working minute of the shift. You can always count on powerful, rugged Exides for dependability, long-life, safety and ease of maintenance. *These are the factors which add up to lower handling costs per ton.*

Write us for a FREE copy of the bulletin "Unit Loads," prepared by The Electric Industrial Truck Association. It tells how to cut handling costs up to 50% . . . covers latest developments in materials handling . . . and includes actual case histories.

Exide
IRONCLAD
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32

Exide Batteries of Canada, Limited, Toronto

Why Worry about Lubrication?

8 Balanced Design Features

OF RELIANCE SERIES C MOTORS

1. **Protecting enclosures** keep out dirt, chips, oil, excess moisture.
2. **Steel stators for strength.**
3. **Thirteen-step winding treatment,** for maximum stator protection.
4. **Pressure cast aluminum rotors** provide trouble-free windings.
5. **Heavy shafts,** liberally designed for added strength.
6. **Improved bearing lubrication** affords *real* protection to bearings and windings.
7. **Optional lead outlet arrangement** permits machine mounting with elimination of conduit box.
8. **Flange and face type brackets** offer alternative methods of machine application.

● Reliance Series C Motors are designed and precision built *to make it absolutely impossible to grease them wrong.* On the vast majority of applications, these factory lubricated motors continue to operate *for years* with no additional lubrication whatsoever. In cases where unusual conditions make occasional attention necessary—or if it is your practice to lubricate at regular intervals—undergreasing or overgreasing make no difference. Write for Bulletin C-118 which tells the whole story—and specify Reliance Series C Motors to forget lubrication worries.

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RELIANCE A-C D-C MOTORS

Where 8 FEI FURNACES

equalled the output of 13 other furnaces

F.E.I.

Direct Fired Cover Annealing Furnaces for coiled strip, tin plate, flat sheets, wire and rod.

Spheroidizing, Normalizing and Bright Annealing Furnaces.

Galvanizing, Patenting, Lead Annealing and Salt Furnaces for the wire industry.

Galvanizing Furnaces for pipe, sheets, and the jobbing trade.

CONVERSION of any existing cover annealing furnaces to F.E.I. Direct Fired System.

● A steel company operating nine Cover Annealing Furnaces needed four additional units—or thought they did—to handle their production.

Upon investigation, F. E. I. engineers made this suggestion: "Let us begin by converting your present units to the F. E. I. Direct Fired System, and by that time you will know exactly how much additional capacity you need, if any . . ."

This plan was adopted, and by the time eight of the old furnaces had been converted, their output had been so stepped up as to equal that of their nine old furnaces plus the four new units they first thought they needed.

Results like these are the rule rather than the exception wherever the F. E. I. Direct Fired System replaces other types of heating equipment. Along with improved quality and minimized investment go space saving, negligible maintenance cost, and fuel economies which are the more appreciated in view of all the other advantages gained.

Write us for information and recommendations.

FURNACE ENGINEERS, Inc.

Specializing in the design, manufacture and installation of furnaces for the metal working industries

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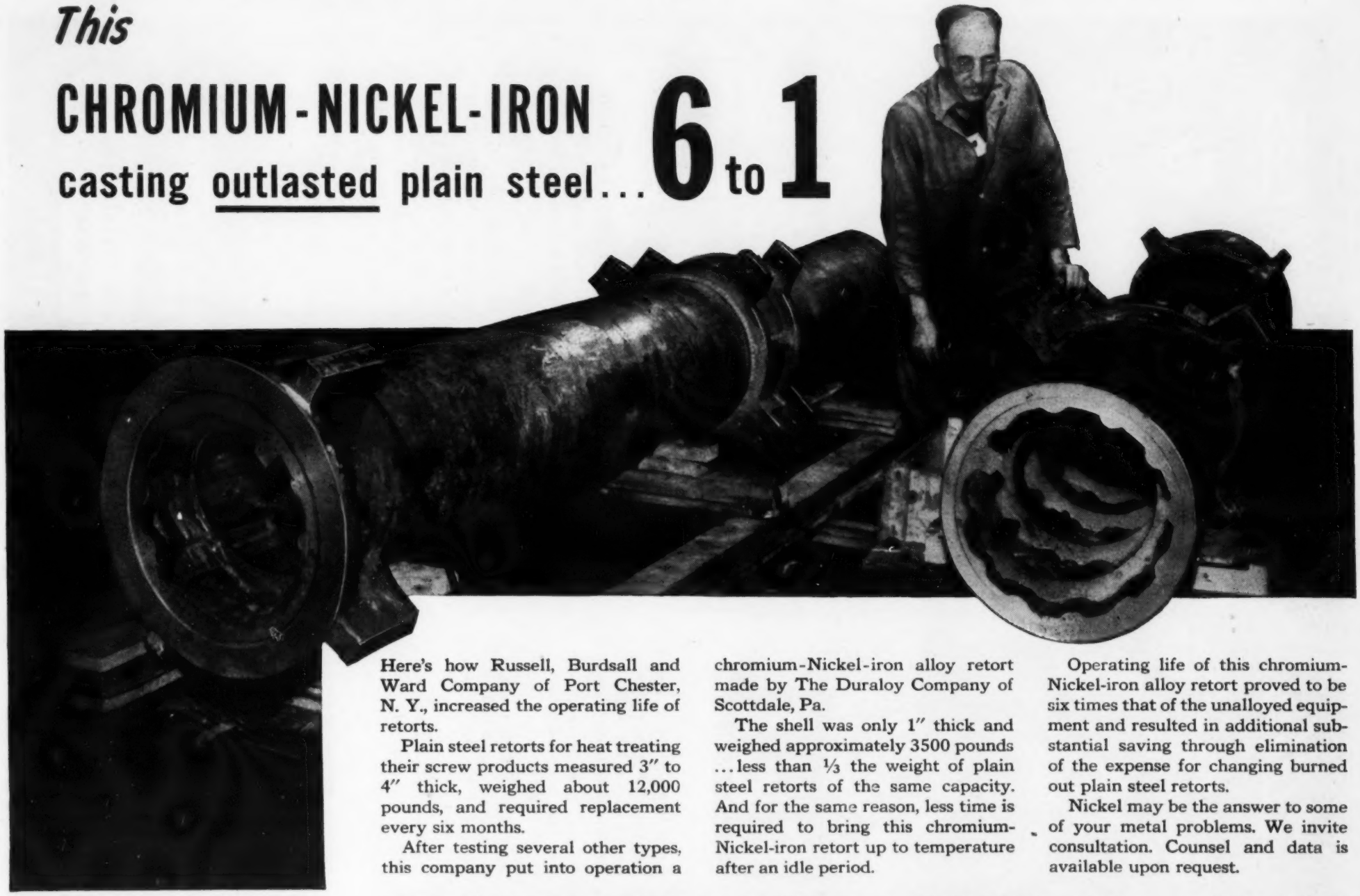
This

CHROMIUM-NICKEL-IRON casting outlasted plain steel... 6 to 1



Here's how Russell, Burdsall and Ward Company of Port Chester, N. Y., increased the operating life of retorts.

Plain steel retorts for heat treating their screw products measured 3″ to 4″ thick, weighed about 12,000 pounds, and required replacement every six months.

After testing several other types, this company put into operation a chromium-Nickel-iron alloy retort made by The Duraloy Company of Scottdale, Pa.

The shell was only 1″ thick and weighed approximately 3500 pounds ... less than ⅓ the weight of plain steel retorts of the same capacity. And for the same reason, less time is required to bring this chromium-Nickel-iron retort up to temperature after an idle period.

Operating life of this chromium-Nickel-iron alloy retort proved to be six times that of the unalloyed equipment and resulted in additional substantial saving through elimination of the expense for changing burned out plain steel retorts.

Nickel may be the answer to some of your metal problems. We invite consultation. Counsel and data is available upon request.

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THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

The all-important operation of shifting mandrel rods and troughs in and out of dies on this new drawbench is controlled by Quick-As-Wink valves. Many manufacturers of drawbenches use valves made by C. B. Hunt & Son, Inc.

Engineers choose Quick-As-Wink valves because of their long record of dependable, maintenance-free service. Their U-shaped packers are pressure sealed against internal leakage. Plungers and bodies on ALL Hunt valves are buffed and polished stainless steel.

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THE HIGHER THE PRESSURE AIR WATER OIL THE TIGHTER THE SEAL

VARNISHED FIBERGLAS-AND-FIBER

DUPLEXED VARNISHED FIBERGLAS

SPECIAL THIN SLOT INSULATIONS

3 IMPROVED SLOT INSULATIONS BY IRVINGTON

Irvington again sets the pace with three improved insulations:

Varnished Fiberglas-and-Fiber, that combines the heat and moisture resistance and high mechanical strength of flexible Fiberglas with the high insulating qualities of Irvington formulated varnish.

Duplexed Varnished Fiberglas, that furnishes added protection against high temperatures and dampness with two layers of varnished Fiberglas that are flexibly bonded together, providing increased dielectric and mechanical strength and improved cushioning effect.

Special Thin Slot Insulations, consisting of varnished Fiberglas, rayon, nylon or cambric, duplexed to rag paper, in extremely thin combinations which provide high dielectric insulations for narrow and shallow slots wherever space is limited.

With these three additions to its broad line, Irvington further increases its leadership in the production of slot insulations to meet all operating conditions and requirements. Complete cooperation in fulfilling your needs is freely offered. Write Department 56.

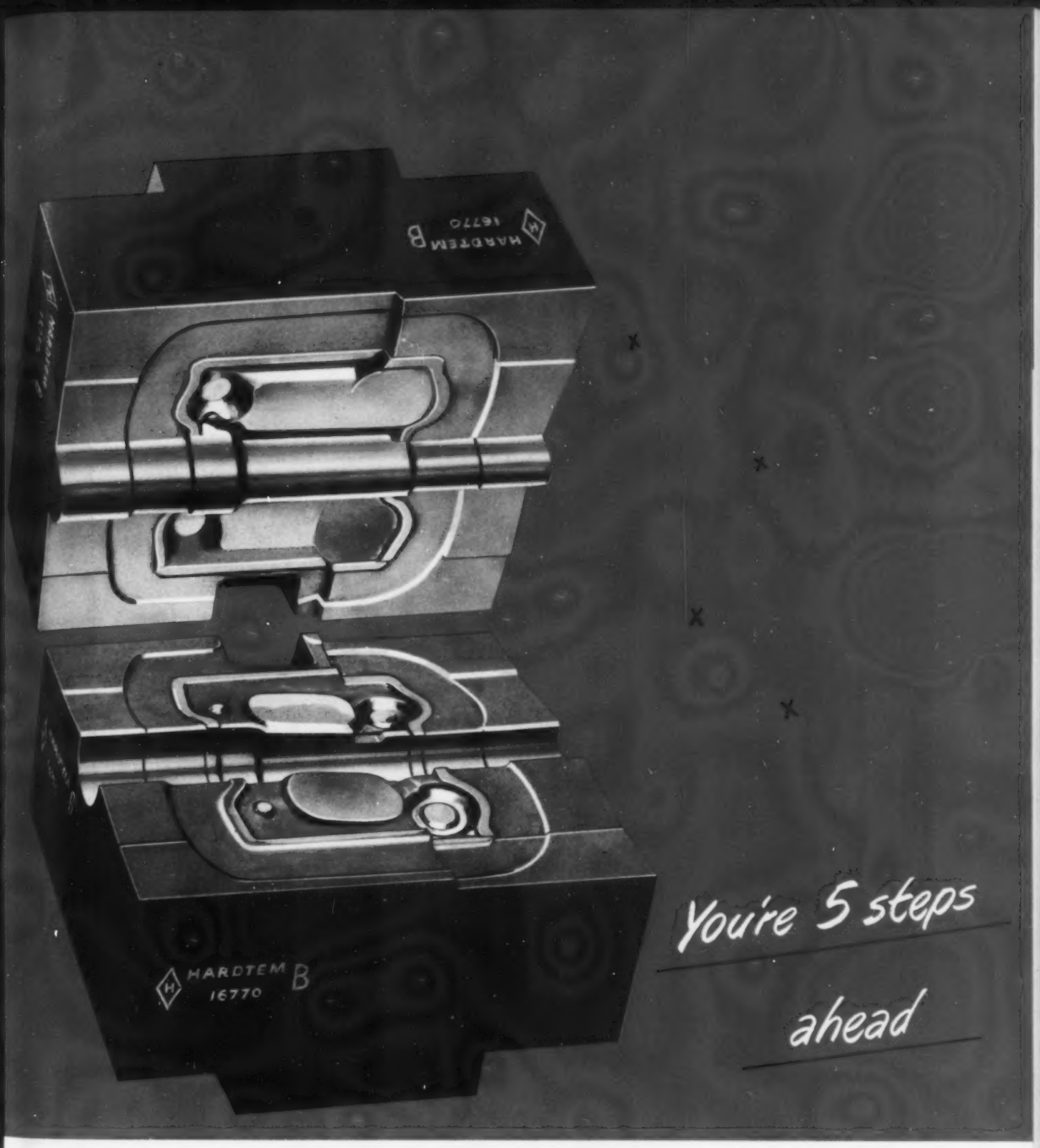
Other Irvington products include . . . insulating varnish, plastic tubing and tape, varnished tubing, varnished fabrics, varnished Fiberglas, wire markers, Cardolite Compounds.

IRVINGTON

VARNISH & INSULATOR CO.

Irvington 11, New Jersey, U. S. A.

LOOK TO IRVINGTON FOR CONTINUED LEADERSHIP IN INSULATION



You're 5 steps ahead

with Heppenstall Die Blocks

IT'S NOT SURPRISING, that Heppenstall's customers represent the leaders in the forging field. Heppenstall's *exclusive* Hardtem process gives them a five-point lead. It assures (1) easier machinability, (2) adaptation for use without heat treatment by the user, (3) an impression that can be resunk repeatedly without annealing, (4) a block that can be replaced in service without hardening, and of course, (5) *more forgings per sinking.*

THEN TOO, people who are alert to such basic manufacturing advantages are certain to be on their toes in other phases of their business. Heppenstall Co., Pittsburgh 1, Pa.

Heppenstall

the most dependable name in die blocks

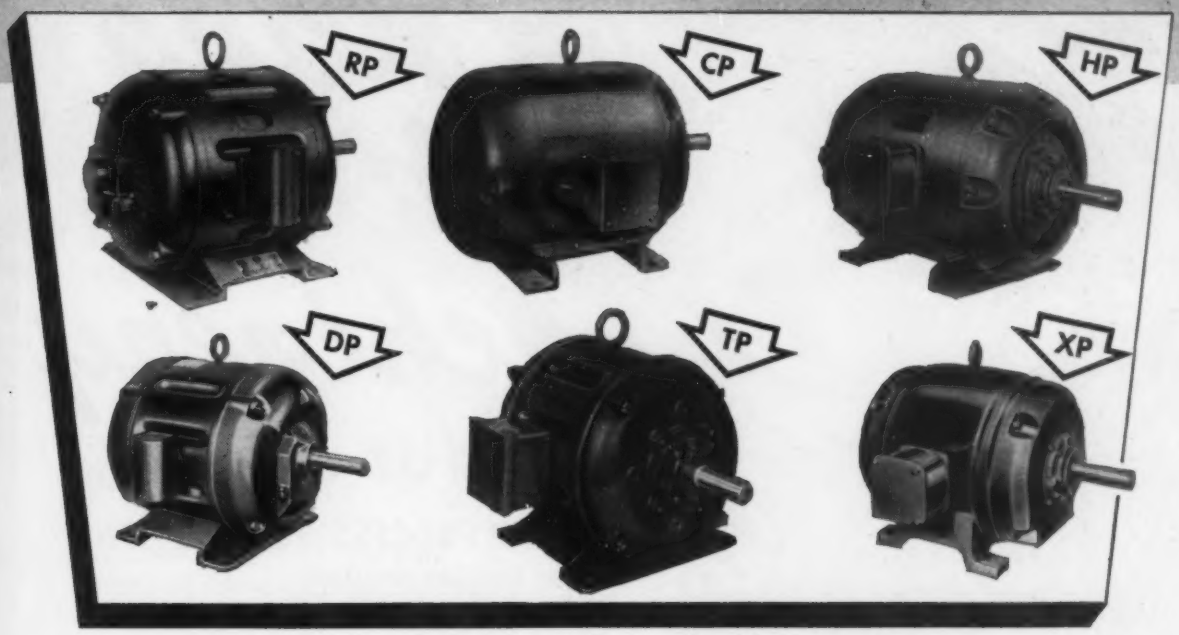
POOLE

COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

OLE FOUNDRY & MACHINE COMPANY WOODBERRY, BALTIMORE, MD.

Wagner offers a Complete Line of Motors for all Industrial Applications



Wagner motors (shown here in their electrical and mechanical variations) embody the latest developments in design. They are simple, rugged and dependable and have long life in addition to good electrical performance.

The tables below show the electrical and mechanical types of Wagner polyphase squirrel-cage and wound-rotor motors available for industrial applications.

ELECTRICAL TYPES OF WAGNER POLYPHASE MOTORS

Type	Ratings	Electrical Characteristics	Applications
RP-1	1-10 to 400 hp 3- and 2-phase 25 to 60 cycles 110 to 2300 volts	Normal Torque—Normal Slip	Group or individual drives on machine tools, fans and blowers, compressors, centrifugal pumps—on any applications where normal-torque motors are satisfactory.
RP-5	1½ to 100 hp 3- and 2-phase 60 cycles 110 to 2300 volts	High Torque—Normal Slip	Crushers, plunger pumps, belt conveyors starting under load, large air compressors, large refrigerating machinery, mixers, and other applications requiring high starting-torque.
RP-6	½ to 150 hp 3- and 2-phase 25 to 60 cycles 110 to 2300 volts	High Torque—High Slip	Punch presses, shears, metal-drawing operations, balers and other machinery equipped with flywheels or having flywheel effect.
RP-7	1 to 50 hp 3- and 2-phase 25 to 60 cycles 110 to 550 volts	High Torque—High Slip	Elevators, cranes, hoists, dumbwaiters.
RS-1	1 to 250 hp 3- and 2-phase 25 to 60 cycles 110 to 550 volts	Continuous Duty—constant and adjustable varying speed	Conveyors, compressors, pulverizers, etc., requiring continuous operation.
RS-2	2 to 200 hp 3- and 2-phase 25 to 60 cycles 110 to 550 volts	Intermittent Service—Crane and hoist duty	Elevator, crane, hoist, and like services which operate intermittently.

MECHANICAL TYPES OF PROTECTED AND ENCLOSED SQUIRREL-CAGE MOTORS

Type	Ratings	Mechanical Characteristics	Applications
CP	1½ to 125 hp 2- or 3-phase 25 to 60 cycles 110 to 2200 volts	Totally-Enclosed Fan-Cooled	Locations where dust, filings, fumes, moisture, and other abrasive and corrosive agencies shorten the life of open-type motors.
HP	¾ to 125 hp 2- or 3-phase 25 to 60 cycles 110 to 2200 volts	Explosion-Proof	For Class 1 Group D locations involving flammable volatile liquids, highly-flammable gases, and other highly-flammable substances.
TP	¼ to 15 hp 2- or 3-phase 25 to 60 cycles 220, 440, or 550 volts	Totally-Enclosed Nonventilated	(The equivalent of type CP, but in smaller ratings not needing external fan cooling.)
DP	¼ to 5 hp 2- or 3-phase 25 to 60 cycles 110 to 550 volts	Dripproof	Locations involving dripping liquids and falling metal chips and other particles.
XP	¾ to 50 hp 2- or 3-phase 25 to 60 cycles 110 to 550 volts	Splashproof	For outdoor and indoor locations where motors are subjected to splashing liquids.

M45-21

OTHER WAGNER PRODUCTS

Write for Bulletin TU-180 on Wagner Transformers, and Bulletin IU-186 on Wagner Industrial Hydraulic Braking Systems.

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MECHANIZED MOLD PREPARATION USED BY NATIONAL TUBE COMPANY

▲Three big-end-down 23½ x 26½ x 80 inch ingot molds can be water dipped and pitch coated every two minutes, using a new setup perfected at the National Works plant of National Tube Company, United States Steel Corporation subsidiary, during the past year. This new system of mold preparation uses less than half a pound of prepared coal tar pitch per ton of ingots.

The operations consist of picking up three hot (300-500-F) molds by means of a special lifting rig attached to the 15-ton mold yard crane, dipping the set into water to remove any dirt, and positioning them on a special spray platform. The mold lifter, seen in Figure 1, is lowered until the cover plate, suspended by chains within the frame work of the lifter, rests on top of the molds. Compressed air then blows in the powdered coal tar pitch through three conical depressions centered under the molds in the base of the platform. The cover plate keeps all but a small part of the pitch from escaping into the atmosphere.

A uniform coating from top to bottom of the mold is obtained with 85-95 psi air pressure delivering the powdered pitch through a 2-inch pipe. At this pressure only five seconds is required for sufficient pitch to be siphoned into the mold to produce a coating of sufficient thickness to repel steel splashes during teeming, and provide the agitation necessary to prevent non-metallic scum from being trapped in the ingot surface. Exact control of the flow to each of the three molds is obtained through a motor operated cam arrangement that opens three quick-acting air valves, one at a time, for five seconds each. A single push button operates the motor for a single blowing cycle, a time switch breaking the circuit after the cams, which are driven through a set of gears, have made one complete revolution. Individual operation of any of the three blasts can be secured by depressing the valves by hand as desired. Figure 2 shows the control setup.

Figure 2 — Control setup for mold preparation.

As soon as the third mold has been coated, the crane picks up the set of three and returns them to their positions on the ingot buggy, the stools having been blown clean while the molds are being sprayed.

Air is blown into the bottom of the hopper to agitate the powdered pitch, which otherwise tends to pack, and assures a constant supply of powder to the suction line leading to the mold being coated. A screen just above the suction intake serves to remove any

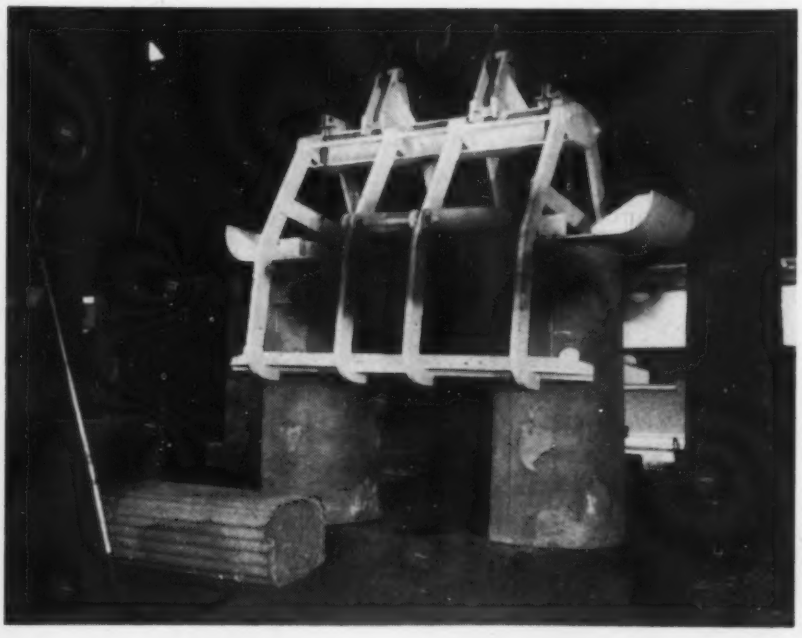

Figure 1 — Special mold lifter rig which is attached to a 15-ton mold yard crane.

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dirt or lumps that might clog the spray system.

Provision is also made to prepare big-end-up molds by means of a hand spray, also connected to the pitch hopper. After the molds have been dipped in water they are suspended over the coating platform and a goose-neck spray pipe with a cone-shaped nozzle inserted between the cover plate and the mold. A foot pedal operated valve near the coating platform controls the compressed air to the siphon and hopper and the shape of the nozzle serves to distribute the pitch evenly over the mold walls.

Experience shows a very substantial decrease in scrap and scarfing required since the new mold preparation system was placed in operation and the coating is considered superior to any previously secured with tar, fuel oil, graphite or brine.

LORAIN WORKS IMPROVE PIPE PRODUCTION

▲ Plans to improve production facilities for manufacture of butt weld pipe to meet postwar demands at Lorain Works of National Tube Company at Lorain, Ohio, were announced recently by C. R. Cox, president of this United States Steel subsidiary.

The Lorain project, designed to improve production methods and to meet requirements of new housing construction, is a part of a long-range modernization and improvement program begun before the war by subsidiary companies of United States Steel.

Under the program, production of standard pipe in butt weld sizes, three inches and smaller, by National Tube Company would be concentrated at Lorain Works. Improvements announced recently, which will increase the efficiency of Lorain butt weld mills and related facilities, are expected to be completed during 1946, Mr. Cox said, adding that further development of these operations is already under consideration.

MICARTA BEARINGS SUCCESS IN STEEL MILLS

▲The combination of two types of Micarta bearing materials has proved successful as bearing shells for three-high sheet mills over a period of several years.

The inside surface of these bearing liners consists of 15 ounce per square yard cotton cloth impregnated with phenolic resin containing a mineral hardening agent. This type of composition is used for about 3/8 in. of the wall thickness. The outer portion of these liners consists of heavy 50 ounce per square yard cotton cloth impregnated with phenolic resin. The treated materials are molded together in one operation under heat and pressure to form dense, tough bearing liners.

This combination produces a bearing liner with a hard, long-wearing bearing surface with a tough back to cushion shock loads. The 50 ounce cloth on the backs of these liners has a high impact strength, and therefore, reduces the tendency of the liners to crack under high shock loads.

Liners such as these are well suited for three-high sheet mills since the rolls are driven continuously at a speed great enough to work well with mineral filled composition bearings. The low rate of wear of these resilient bearing liners means that it is easier to hold gauge on the sheets being rolled.

Above photograph shows a Micarta bearing for a 3-high sheet mill.

COR-TEN CARS SHOWN AT C-I STEEL EXHIBIT

▲ In connection with the tenth anniversary of the first commercial production of USS Cor-Ten, a low-alloy high-strength steel enabling production of lighter weight mobile equipment, committees of the Association of American Railroads and the American Railway Car Institute attended an exhibit of freight cars made of this material which was held at the Homestead Works of Carnegie-Illinois Steel Corporation on October 10.

The two committees which made the inspection trip to the U. S. Steel subsidiary plant were the Committee on Car Construction of the Mechanical Division, Association of American Railroads and the Design Committee of the American Railway Car Institute.

The inspection party examined some 14 various types of railroad cars that have been in service for the greater part of the 10 years that Cor-Ten has been in production.

EXIDE BATTERY POWERS ELECTRIC TORPEDO

▲ Driving the silent and wakeless electric torpedo through the water on its mission of blasting the Jap navy into oblivion was an Exide battery of remarkable power for its size and weight, it was announced with Navy permission by The Electric Storage Battery Company, Philadelphia.

This Exide was the key to the successful operation of the electric torpedo which played such an important part in the destruction of the Japanese navy. Although it could be discharged and recharged, this battery actually was destined to give one burst of tremendous power quickly released and sustained long enough for the torpedo to reach its target and then be expended in the bowels of the enemy ship. Its mission was self-sacrifice and among the engineers who designed it this Exide was nicknamed the "suicide" battery.

It was a remarkable battery because never before has so much electric power or energy been stored in a storage battery of its size and weight. And without such a battery the ingeniously designed torpedo could not be propelled.

These Exide-equipped electric torpedoes sank 1,856,200 tons of Japanese shipping, representing over 300 vessels, ranging in size from merchant vessels of a few hundred tons to a 42,500 ton Jap battleship.

Prior to World War II the Navy Department called for an electric torpedo. The problem of designing such a torpedo, including the electric motor which propelled it, was handed to the Westinghouse Electric Corporation. The problem of designing the battery was given to Exide, which, with its many years of experience in building the batteries for U. S. Navy submarines, promptly went to work. Working in conjunction with Westinghouse engineers, Exide was able to key the characteristics of the storage battery with those of a specially designed electric motor.

Exide solved the battery problem by developing a special active material which, applied to very thin plates, would provide the maximum capacity in the smallest possible space. This remarkable Exide has the most capacity per pound that has ever been produced in a storage battery. Exide is the only manufacturer making this "suicide" battery.

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ADVANCES IN ARC WELDING WILL AID POSTWAR CONSTRUCTION

by A. F. DAVIS

Vice President, The Lincoln Electric Company, Cleveland, Ohio

▲ Although the process of arc welding had come into its own long before the outbreak of the war, no other fabricating medium has made such phenomenal progress during recent years.

The tempo of war production required heretofore undreamed of fabricating speeds in order to meet current demands, and engineering research in the art of welding made possible the advancements in equipment and welding techniques to meet such demands. In the light of these developments, it is reasonable to assume that these newly perfected ideas in arc welding machines and methods will be widely utilized and expanded even further to increase the output and quality of innumerable metal articles to add to the convenience and enjoyment of peacetime living.

Recent improved additions to the line of manual and automatic welders, electrodes and welding accessories manufactured by Lincoln Electric are described in the following paragraphs.

Engine driven model SA200 "Shield-Arc" welder (*Figure* 1) — This new welder embodies innovations in design to increase the usefulness and efficiency of the engine-driven type welder. It differs from previous models of 200 ampere capacity in (1) the "job selector" which varies speed of engine for welding duty giving accurate control of open circuit voltage resulting in improved welding control, minimum fuel consumption and engine wear; (2) powered by 4 cylinder, Continental engine of 29 hp at 1400 rpm; (3) supplied complete with base and canopy; (4) rubber-cushioned engine mounting for smoother operation. This welder can be supplied with either rubber-tired or steel-tired trailer for high speed road trailing.

"Fleetwood 35" — A new general purpose shielded arc electrode made specifically for operation on a-c but which will also operate on d-c with either polarity, has all the dependable characteristics of the popular Lincoln "Fleetweld" electrodes for high speed welding of single or multiple passes of mild steel in all positions.

"Fleetweld 37" — A new general purpose electrode with an extremely stable arc that does not tend to burn through even when welding light gauge sheet or work where fit-up is poor. Has all the desirable characteristics of the shielded arc method such as minimum spatter and slag loss, uniformity of deposit and superiority in physical properties of the weld metal.

Type GC-3 ground clamp — A new low-priced ground clamp designed so that each jaw connects independently to the ground cable. Thus, if one jaw fails to make contact due to heavy paint, scale, etc., the other jaw will carry the current. Has heavy duty steel frame with copper conductors and contacts, a maximum jaw spread of 2½ in., and weighs only 1½ lb.

"Fleet Welding" method of arc welding — An entirely new method developed for the welding of mild steel, called "Fleet Welding," not only greatly increases the speed of the process but, introduces a technique of arc welding which cuts costs as much as 59 per cent. The new method utilizes "arc force" to speed up the welding and effect desired penetration of joints.

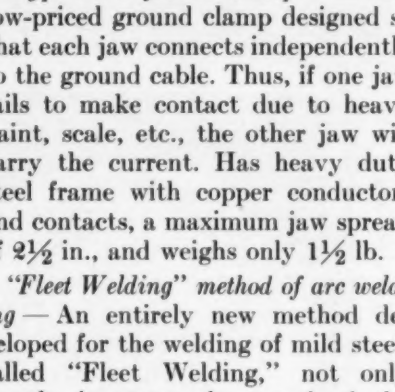

Figure 1

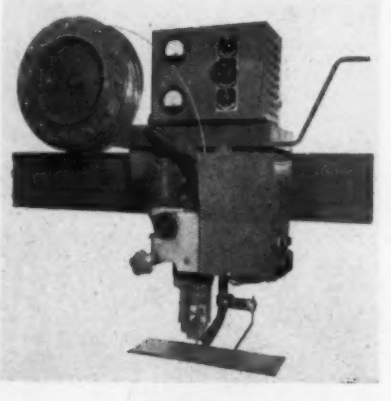

Figure 2

"Lincolnweld" automatic arc welding — A new type of automatic welding known under the registered trade mark of "Lincolnweld," has proved to be much simpler, faster and more economical in operation than any known existing method of automatic arc welding.

Developed to meet the need for a more foolproof and easier applied process, "Lincolnweld" has established its practicability over a period of several years during which a number of the units have been highly successful in welding a variety of products, among which are tanks and pressure vessels of all kinds, piping, machinery and motor parts, ventilating fans, many parts used in the prefabrication of watercraft, railroad cars, etc.

The process is designed for use with direct current, utilizing a bare metallic electrode which is fed through a granular flux deposited on the butt, lap, tee, fillet or corner joint to be welded. The flux, which completely blankets the arc and molten metal, is reclaimed after welding for further use.

Figure 2 shows the welding head, flux hopper, wire reel and control mounted on a motor driven carriage. A straight wire guide may be used for butt welding. For square butt welding, a pointer is used for following irregular seams. For prepared joints roller guides are provided for engaging the seam.

With the many benefits offered by these new advancements, it is obvious that the future will see an even greater utilization of the electric arc methods and should thus create a fairly consistent market for the iron and steel industry.

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AMERICAN BRIDGE CO. TO MODERNIZE GARY PLANT

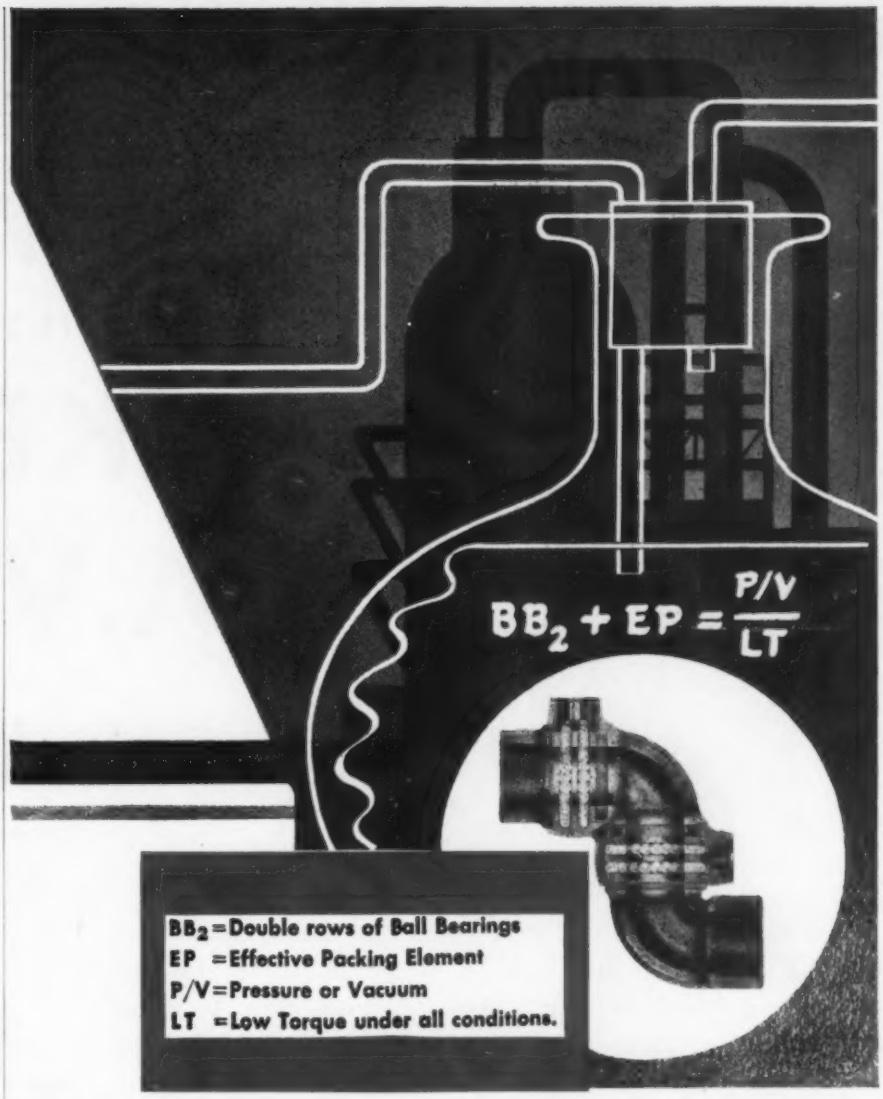
▲ American Bridge Company, United States Steel corporation subsidiary has announced broad plans for modernization of its plant in Gary, Indiana. L. A. Paddock, president of the company, announced the postwar program and explained the improvements are being made to meet increasing demands for fabricated steel in mid-western and western states. The American Bridge project in Gary is part of a long-range program launched during prewar years by subsidiary companies of U. S. Steel.

The Gary plant of American Bridge, adjoining the giant Gary Steel Works and Gary Sheet and Tin Mill of Carnegie-Illinois Steel Corporation, another of the U. S. Steel subsidiaries, was built in 1911. During the war the plant built aircraft carrier sub-assemblies and radar equipment for the Navy, and earth-moving equipment which speeded construction of new bases all over the world. The plant flies the Army-Navy "E" flag with four stars, the last of which was awarded after V-J Day. In peacetime the plant will turn out structural steel for all types of steel construction, including buildings, bridges, turn-tables and other similar structures.

Output of the Gary plant is expected to be substantially increased by the changes which are planned. Working area of the plant will be increased by nearly 10 per cent, and rearrangement of fabricating facilities and production equipment, increase and centralization of the welding area, enlargement of the under-roof painting area and relocation and combination of certain service facilities are designed to improve postwar operations and service to customers.

NEW HUMIDITY METER USES DEW-POINT CUP PRINCIPLE

▲ Closer control of the effects of water vapor in air or other gaseous mixtures is afforded by a new dew-point recorder now offered by Surface Combustion, Toledo, Ohio. The new recorder thus is especially applicable for furnaces utilizing prepared gas atmospheres, or wherever dehydrated air or a gas mixture of controlled moisture content is desirable, as in


$BB_2 + EP = \frac{P/V}{LT}$
BB_2 = Double rows of Ball Bearings
EP = Effective Packing Element
P/V = Pressure or Vacuum
LT = Low Torque under all conditions.

CHIKSAN FORMULA for PERFECT FLEXIBILITY
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CHIKSAN *Ball-Bearing* Swivels are widely used throughout the Chemical Industry on loading and unloading lines, on process equipment... in every place where perfect flexibility with low torque is required under pressure or vacuum. Built of malleable iron, steel, special alloys, bronze or aluminum, Chiksan Swivels are used on flexible lines handling acids, alkalies, gasoline, oil, steam and many other liquids, gases and vapors under pressures to 3,000 p.s.i. and varying temperatures.

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To cut down wire-failure possibilities in hot spots, you need wire and cable that will stand up to the beating that insulation gets in circuits running close to kilns, steam lines, furnaces, forging presses, soaking pits, etc. Rockbestos A.V.C.—the wire with the *permanent insulation*—is your solution to every trouble-spot location. Built to take the baking heat of 230°F., Rockbestos A.V.C. won't become brittle, won't crack, flow or de-center. And because it resists oil, grease, alkalies and corrosive fumes, it won't bloom, swell or rot.

Make a check of all your circuits before trouble starts. Then install Rockbestos A.V.C. wires, cables and cords and get trouble-free long-lived performance.

One or more of the 125 Rockbestos Standard and National Electrical code types will fit your needs exactly. For detailed information and catalog, write nearest district office or:

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The Wire with Permanent Insulation

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LOS ANGELES SAN FRANCISCO SEATTLE PORTLAND, ORE.

ROCKBESTOS A.V.C. 600 VOLT POWER CABLE
(National Electrical Code, Type AVA—max. operating temp. 110°C.)

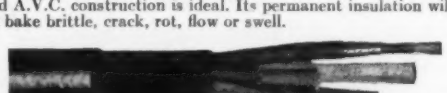
Sizes No. 18 AWG to 1,000,000 CM insulated with two walls of impregnated felted asbestos, varnished cambric and asbestos braid. Other constructions for service voltages to 5000.

You can use Rockbestos A.V.C. Power Cable for hot-spot wiring, in conduit or open, around boiler rooms, steam lines, furnaces, etc., and for power leads of heat-exposed electrical equipment as it withstands high temperatures and has ample moisture resistance. Use similarly insulated Rockbestos A.V.C. Motor Lead Cable for motor leads and coil connections.

ROCKBESTOS A.V.C. 600 VOLT BOILER ROOM WIRE
(National Electrical Code, Type AVA—max.operating temp. 110°C.)

Sizes No. 18 to 8 AWG insulated with varnished cambric, impregnated felted asbestos and asbestos braid. Sizes 6 to 4/0 have another wall of impregnated asbestos next to the conductor.

For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A.V.C. construction is ideal. Its permanent insulation will not bake brittle, crack, rot, flow or swell.



ROCKBESTOS A.V.C. 600 VOLT CONTROL CABLE

In one to 19 conductors with individuals insulated like Power Cable, cotton braid covered, and cabled with an asbestos braid overall. Standard strandings A.W.G. No. 12—19/#25 and No. 9—19/#22. Other strandings on order.

Designed for use in equipment requiring a multi-conductor control cable capable of withstanding high temperatures, this cable is widely used in the control systems of electric cranes and other equipment used in steel mills. The insulation is unaffected by heat, corrosive fumes, oil or grease and has ample moisture resistance.

Another New Rockbestos Firewall Construction—A 400°F. Wire!

War-developed Rockbestos High-Temperature Wire—*with a maximum operating temperature of 400°F.*—designed for jet propelled plane applications and circuits to hot-wing de-icers, fire detectors and extinguishers, and air conditioning and heating units where baking temperatures destroy ordinary insulation. Under continuous operation at rated temperature it retains its original dielectric strength and inherent resistance to heat and flame, and *progressively improves* in its resistance to moisture and abrasion. Now available for these and other severe applications. Write for complete information and samples.

the chemical and food processing industries, drug preparation, etc.

The new recorder can provide a virtually continuous record of humidity within a temperature range of from minus 70 to plus 60 F. More precise and more frequent adjustments of the various constituent gases in the atmosphere can thus be made to compensate for differences in humidity. Or if humidity control of the air or gaseous atmosphere is used, permanent information concerning its dew point is provided.

The recorder applies the principle of the dew-point cup, which has long been used in its original form for determining the humidity of air and other gaseous mixtures. Its operation is therefore independent of the nature or composition of the gases making up the atmosphere. The presence of "impurities" in the furnace gases, such as hydrogen sulphide and sulphur dioxide have no effect upon its accuracy. Hence an analysis of the furnace gas, previously the customary method of checking for the desired humidity and often the only method used, is unnecessary.

NEW MACHINE TRIMS AND CUTS SCRAP

▲ A 110 in. rotary plate trimmer and scrap cutter, which can trim both sides of 1¼ in. thick mild cold steel plate and simultaneously shear the scrap into short lengths for charging back into the open hearth, is one of the latest developments announced by the Lewis Foundry and Machine Division of the Blaw-Knox Company.

The operation is performed at speeds from nine to 60 fpm. The scrap cutter consists of up-and-down shears which travel at the exact speed of the plate through combination synchronized gear drives off the main rotary knife arbors.

They cut alternately, thus reducing shearing power. The scrap shears are pivoted in cranks back and below each of the rotary knife heads and travel through an arc equivalent to the radius of the sheared scrap leaving the plate.

The machine is powered by twin 200 hp motors which drive both the

Cross sectional view of one heating element, showing directional flow of the combustion gases.

The three element KEMP immersion heating unit, practical for the melting of all soft metals.

KEMP

IMMERSION MELTING UNITS

Immersion Heating Elements Minimize Loss of Heat Thus Greatly Reducing Maintenance Expense

Notice in the diagram how the exhaust gases are utilized in the design to raise temperatures. Exhaust vents are so located that a blanket of exhaust gases is formed over the surface of the molten metal which materially reduces the formation of dross. This factor plus a more accurate temperature control and the extraordinary efficiency of immersion heating, effect a substantial saving in fuel costs.

Adaptable for purposes other than the heating of soft metals, the KEMP immersion application has been employed in many instances.

Additional information in the form of bulletin E 200.1 will be forwarded upon request.

Numerous Other Kemp Products Include:

ATMOS GAS PRODUCERS, NITROGEN GENERATORS, FLAME ARRESTORS, INERT GAS PRODUCERS, DYNAMIC DRYERS, INDUSTRIAL CARBURETORS, INDUSTRIAL BURNERS, FIRE CHECKS, STEREOTYPE POTS

The C. M. KEMP Manufacturing Co.

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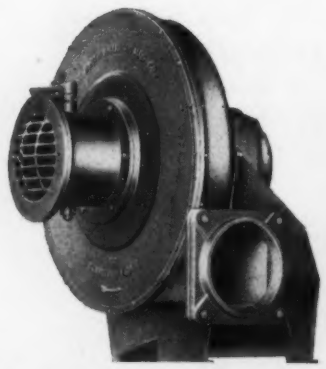
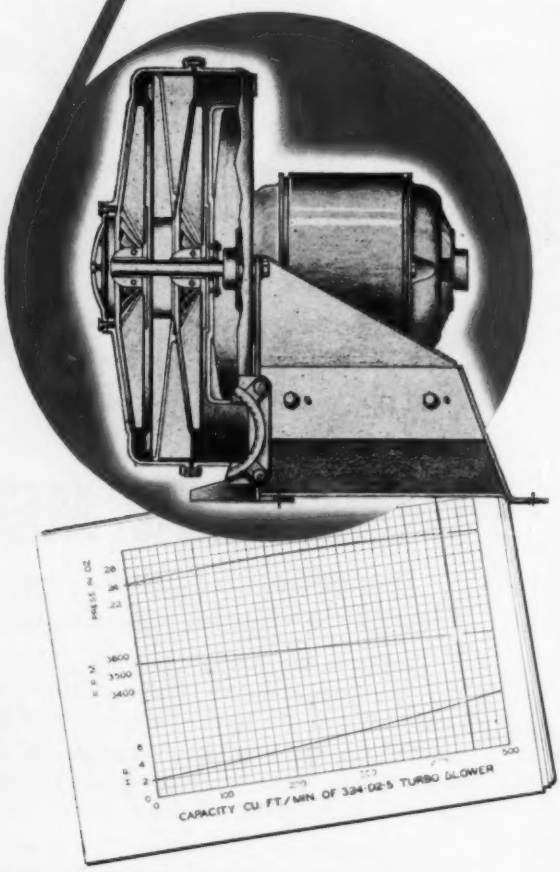
TURBO BLOWERS



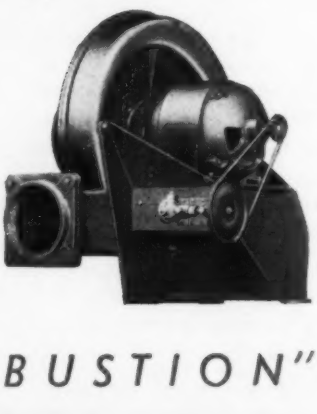
(ABOVE) DIRECTLY CONNECTED. Butterfly valve on intake is standard equipment on larger sizes only. Smaller sizes equipped with intake guard—see section at right.

(BELOW) V-BELT DRIVEN. Used where 60 cycle A. C. current is not available.



(ABOVE) DIRECTLY COUPLED facilitates motor change. Blowers available in single or multiple stage—pressures from 8 to 32 oz. and volumes from 60 to 4300 cfm.

(BELOW) OIL PUMP ATTACHMENT for plants requiring small oil systems.



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THE NORTH AMERICAN MANUFACTURING COMPANY

MANUFACTURERS OF INDUSTRIAL FUEL BURNING EQUIPMENT FOR GAS OR OIL

BRANCH OFFICES *with* FIELD ENGINEERS *in* PRINCIPAL CITIES

CLEVELAND, OHIO

rotary and the scrap cutters. One head is stationary while the other is powered by a 25 hp gear drive shifting from 19 in. minimum to 110 in. maximum width. All driving gears are provided with lubrication by a motorized oil pump. They also receive automatic grease lubrication where required.

The new machine greatly simplifies the disposal of the scrap from the rotary side shears. Up to this time there had been no practical method of cutting the scrap into pieces of a length that could be charged back into the furnace or otherwise used as short scrap. Previously built scrap cutting machinery, either attached to the rolling mills or built specially, required a considerable amount of maintenance. Engineers of the Lewis Foundry and Machine Division of the Blaw-Knox Company do not believe this will be the case with the new machine they recently developed.

WICKWIRE SPENCER BUYS COBURN TROLLEY TRACK CO.

▲ The Wickwire Spencer Steel Division of the Colorado Fuel and Iron Corporation announced recently the purchase of the business and assets of the Coburn Trolley Track Company of Holyoke, Massachusetts. The steel company will immediately assume full control of all management, production and sales operations of Coburn.

The Coburn Trolley Track Company manufactures a full line of hardware for sliding doors, garage, warehouse, automatic fire and overhead doors and hardware for overhead conveying equipment.

The purchase of Coburn is in line with Wickwire Spencer's policy of expansion to include the manufacture of products and lines closely related with the company's own wire and wire products.

In connection with the new property, Wickwire Spencer announced that it will be known as the Coburn Division. Operations will continue for the present at Holyoke, where Coburn's manufacturing plant and sales offices are located. A. H. Reid, who has been associated with the Coburn Company will continue as sales manager for the Division's products under the direction of A. G. Bussmann, Wickwire Spencer vice president in charge of sales.

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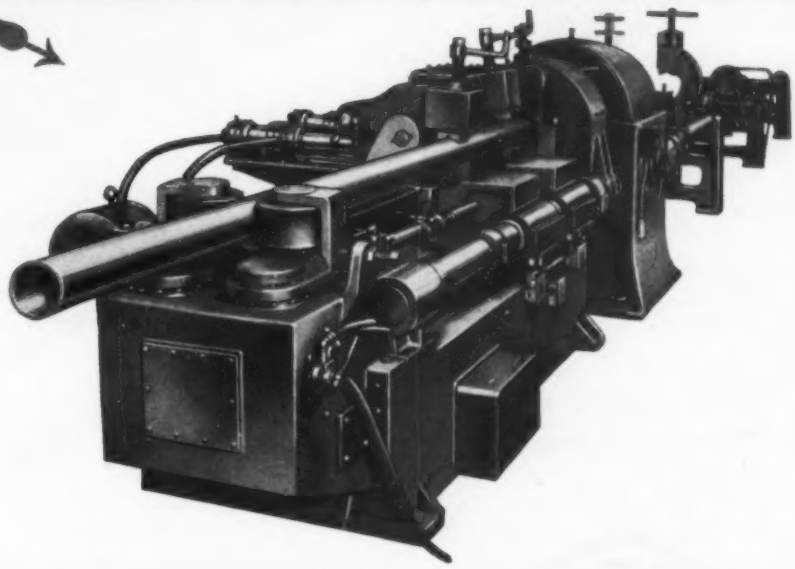
...100% chip recovery

CONTINUOUS • AUTOMATIC • CENTERLESS

BAR & TUBE TURNERS

For speed...and for precision! Continuous, automatic feeding gives you high production unequalled by any other type of turning machine! For both rough peeling and finished precision conditioning, Medart Centerless Bar Turners will turn bars and tubes at maximum rate obtainable from any present day cutting tools. The machines are very flexible. May be used with one or two cutterheads, with one or up to eighteen tools in each head.

"Patents make Jobs"



EQUIPMENT AND SPECIALIZED MACHINERY

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THE MEDART COMPANY • 3500 DE KALB ST., ST. LOUIS, MO.

- ☆ All Steel Construction
- ☆ Mica Insulation
- ☆ Rugged Terminals
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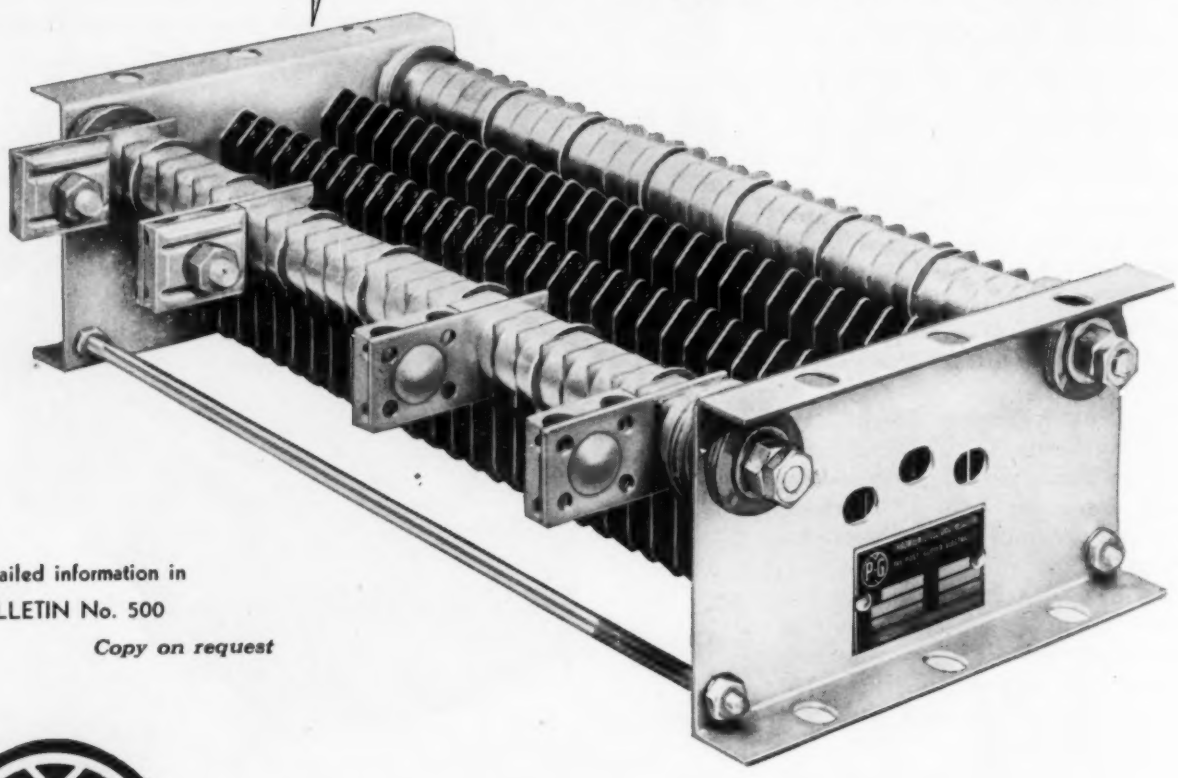
- ☆ Unaffected by Vibration
- ☆ Moisture Resistant
- ☆ Corrosion Protected

Durable

Steel and Mica . . . . . plus unique and exclusive P-G design, result in enduring resistor service. Neither vibration nor moisture laden or corrosive atmospheres have material effect on continuity of service.

Try Post-Glover Steel Grid Resistors for your heavy duty applications where resistors are subject to severe conditions.



Detailed information in
BULLETIN No. 500
Copy on request

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY
• ESTABLISHED 1892 •
221 WEST THIRD STREET, CINCINNATI 2, OHIO

PHOTOTUBE CONTROLS LOOP ON CONTINUOUS STRIP LINE

▲Many strip processing lines require that one or more free loops be maintained in the strip at certain points on the line. Where manual control of motor fields is used to hold such a loop, it usually requires almost constant attention from the operator.

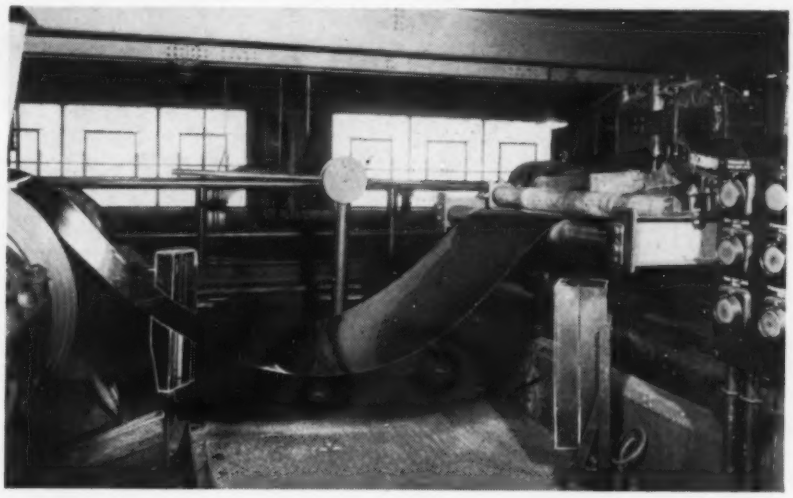


Photo-thyratron loop control applied to a strip processing line. Light source and 20-inch high bank of phototubes shown at right foreground and left background (with strip between), respectively.

Either too much loop or no loop at all will cause trouble.

General Electric recently developed an all-electric method of automatic loop control for strip processing lines. A horizontal light beam of sufficient depth for a good range of modulation is projected on a bank of phototubes, and is partly intercepted by the loop in the moving strip. The signal from the phototubes is amplified and used to control power tubes which supply rectified power to the field of a d-c motor, thus giving continuously modulated control of the loop position. If the loop tends to move from the required position, it changes the amount of light on the phototubes, which transmit this change in signal to the thyratron tubes, which in turn change the motor excitation to bring the loop back into position.

This type of equipment is in successful operation on tin plate cleaning lines operating at 2000 rpm. It is also being used on tin plate flying shear lines to control loops on both sides of the side trimmer. The loop between the payoff reel and trimmer on a shearing line is one of the most difficult applications for equipment of this kind, since the equipment must cover the full range of motor speed control as the coil changes in diameter, and also the inertia of the payoff reel changes over a very wide range as the coil unwinds. These two conditions created unique problems in stability, which have been successfully solved. Several equipments are in successful operation and a larger number will soon be installed.

POWER TRUCK RACKS AID PAPER LIFTS

▲ Racks made from light steel shapes welded into a strong, rigid structure and mounted on wheels have been devised for use by a large publishing house for handling heavy loads of printed paper stock as fast as it comes off the press with an Elwell-Parker low-lift power truck. The racks are about 2 feet wide, 4 feet long, and 4 feet high, and are open at top and bottom for easy loading and unloading. They have two sets of wheels, mounted at both ends on steel struts.

In use, the truck's platform is pushed under the side of the rack, between the two sets of wheels. Either one or two loaded racks, weighing up to a total of 2 tons, may be picked up on the truck's platform and transported quickly in printing plant or stock room. Wheels and light weight permit easy manual maneuvering of the empty racks. Similarly constructed racks may be used to transport a wide variety of materials with power trucks.

BROWN FINTUBE CO. SHOWS ELECTRIC HEATED FINTUBE

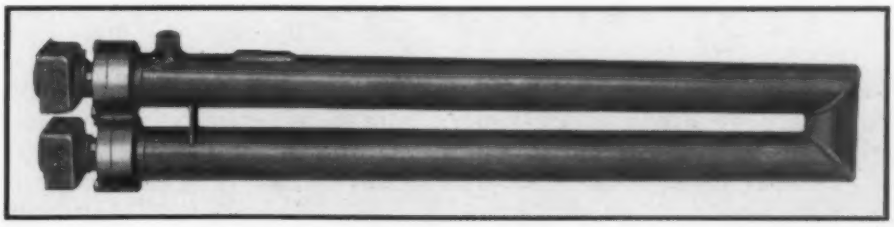
▲ The Brown Fintube Company, Elyria, Ohio, manufacturers of Brownweld one-piece fintubes and fintube heat transfer products, has just introduced a new heat exchanger that employs electrical resistors as the heat source.

According to a company spokesman, the electrical resistors are encased inside a length of standard Brownweld fintube. Current density of typical resistors now in use is 4 kw per linear foot of fintube.

Notwithstanding this high rating on the interior of the fintube, the rating on the outside surface (due to the large ratio of exterior to interior area of the fintube) is only about 8 watts per square inch, thus avoiding high skin temperatures that might cause carbonization of heat sensitive materials, such as sugar syrups and molasses, or coking of hydrocarbons, petroleum products or organic oils.

Brown Fintube electrical resistor heat exchangers are ideally employed when steam is not available, — when it is desired to eliminate the auxiliary piping required when steam is used, —or to heat the fluid to higher temperatures than can be reached with steam.

The electrically operated units insure 100 per cent absorption of heat into the fluid being treated — the temperatures can be more easily controlled than in heat exchangers using steam.



This new fintube employs electrical resistors inside the tube as the heat source.

New Literature

▲ A 270-page technical book entitled "Ball and Roller Bearing Engineering" has been published by SKF here to serve as a fundamental text on all phases of bearing applications to industry.

The book, a bound volume containing some 900 drawings and tables, begins with a technical description of common bearing types and continues through nine chapters of fundamental engineering studies. Both radial and thrust bearings are discussed comprehensively in chapter I together with data on dimensional proportions, running accuracy and tolerances of each type.

"Forces and Motions in Bearings," the second chapter, is devoted to theory and calculations on such subjects as the nature of rolling resistance, friction torque, friction coefficients, stresses and deformations, load distribution, motion and inertia. Other chapters deal with studies in the carrying capacity of ball and roller bearings, bearing selection, design of bearing applications, mounting and dismounting, lubrication and maintenance and bearing failures. The final chapter is made up of tables, conversion values and a description of symbols and abbreviations.

First copies of the book will be sent by SKF to the heads of leading corporations, technical schools and colleges and libraries in principal U. S. cities. Later editions will be sold at cost by the company for students and others interested in bearing studies.

▲ Of an improved design that enables it to dig or rehandle one pound of coal or coke for each pound of bucket weight, the improved class E-15 Hayward grab bucket makes possible significant economies in handling solid fuel. Full details are given in a new Hayward bulletin No. 675 that has just been published by the manufacturers, The Hayward Company, 50 Church Street, New York, New York.

This valuable bulletin will prove helpful to operators of bridge towers, cableways, cranes and other handling rigs who are seeking ways and means of increasing coal or coke tonnage handled at lower cost. It contains interesting illustrations showing the most modern methods in handling coal efficiently, as well as a valuable chart of bucket load capacities, weights and dimensions.

A copy of bulletin No. 675 can be obtained by writing direct to the manufacturers.

▲ The Silbraz joint — the modern threadless connection that actually bonds I. P. S. copper tubing and brass pipe into a single "one-piece" pipe line — is thoroughly described in Airco's new 16-page, 2-color booklet: "How to Cash in on the Silver Ring."

Profusely illustrated, the booklet shows how Silbraz Joints are made from patented bronze pipe fittings, valves and flanges — containing a factory inserted ring of silver brazing alloy in each port opening. The literature shows that when brass pipe or I. P. S. copper tubing is properly inserted in these fittings and the assembly is brazed, the resulting joint is stronger than the pipe itself — a joint that is leakproof; that will not creep or pull apart under any pressure which the pipe itself can withstand.

Additional photographs and text show how the Silbraz Joints resist corrosion and vibration; how they simplify and speed up installation, making it a simple matter to run lines even in hard-to-get-at places.

Other explanatory sections describe the Aircobraze Outfit for making these joints and the many other uses for the outfit.

Copies of the booklet, No. ADG-2017, are available on request from Air Reduction Sales Company, 60 East 42nd Street, New York 17, New York, or any local Airco office.

▲ An illustrated booklet explaining the historical relation between jobs, machines and prices has just been published by the National Machine Tool Builders' Association, Cleveland, who will send copies upon request.

Pointing out that the industrial history of this country is, to a large extent, the application of manufacturers of machines to cut costs, and consequently prices, to where people can buy their products, the booklet cites specific examples of how modern tools contribute to high level employment.

"Jobs today depend more upon human desires, which know no limit, than upon actual human needs," says Tell Berna, general manager of the Association. He goes on to say, "Most of the jobs in American industry today would not even exist were it not for modern production equipment."

The booklet tells how improved machinery contributes to high level employment at good wages in service industries as well as in manufacturing.

▲ High temperature fans for handling hot gases or products of combustion where temperature requirements range from as high as 1800 F are described and illustrated in new bulletin 645 recently printed by the makers, Michiana Products Corporation, Michigan City, Indiana. The chief applications are enumerated, and the novel fan wheel construction of suitable heat-resistant alloys is illustrated.

▲ How, when, and why to use Askania crank type cylinders is told in a new bulletin No. 126 just published by the Askania Regulator Company. They provide a flexible source of hydraulic power with a minimum of gland leakage and maintenance trouble.

Copies may be obtained by writing to 1603 South Michigan Avenue, Chicago 16, Illinois.

▲ A new 20-page brochure, just published by Methods Engineering Council, describes in interesting detail the functions of modern management engineering. The brochure includes a section on general management services, followed by discussions of the Council's work in methods engineering, training, plant layout and design, job evaluation, wage incentive plans, and personnel appraisal.

Copies of the book are available without cost, by writing directly to the headquarters office of Methods Engineering Council, 822 Wood Street, Pittsburgh 21, Pennsylvania.

▲ One of the simplest, most effective methods for handling materials and manufactured products economically and safely is outlined in "Industrial Logistics," a twelve-page, illustrated booklet issued by The Elwell-Parker Electric Company, Cleveland, Ohio.

Subtitled "A Survey for Management," the booklet explains how a planned system of materials transportation reduces costs in procurement, production and distribution of goods. Outstanding examples of economics are cited, such as a reduction of $20.65 per car in unloading sheet metal, $41.00 per car in unloading

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Tune in The Radio Hall of Fame, with Paul Whiteman and His Orchestra, Sundays, 6 P. M., EST; The Breakfast Club with Don McNeill, 9:45 A. M., EST, Monday through Friday—ABC (Blue) Network (Coast to Coast).

MODERN ELECTRIC INDUSTRIAL TRUCKS POWERED BY COST-SAVING PHILCO "THIRTY" STORAGE BATTERIES

Now you can get the kind of industrial trucks war experience proved the safest, most flexible and maintenance-free — ELECTRIC TRUCKS! And you can power your trucks with the greatest materials handling development since the fork-lift truck, itself—PHILCO "THIRTY", the Storage Battery with 30% longer life! Plan now for the big demands peace-time production will place on your materials handling equipment. Philco "Thirty" will give your trucks top capacity, *plus* savings in maintenance, depreciation and replacements. Write today for new catalogs giving specifications.

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PHILCO *Famous for Quality the World Over*

bagged materials; a saving of $64.00 a day through utilizing full warehouse capacity.

Industrial logistics is said to effect savings through using the correct type of containers, such as boxes, barrels, bags and bales; assembling standardized sizes of the individual containers in master unit loads on pallets or skids and then transporting them by means of power industrial trucks. Instead of handling a few pounds at a time, manually, the principle is to handle many pounds, or tons, mechanically at one time.

According to the booklet all containers in which materials and products generally are shipped can be catalogued in the four basic types. Even products requiring no outer protection can be included in one of the classifications, as for example, large rolls of paper are similar in some respects to barrels. Boxes, barrels, bags and bales, therefore, are common denominators in every division of industry; all can be built into master unit loads, to be transported anywhere on pallets or skids.

Auxiliary booklets entitled "Logistics of Boxes," "Logistics of Barrels," "Logistics of Bags" and "Logistics of Bales" also have been prepared.

Copies of any or all of these booklets may be obtained by addressing The Elwell-Parker Electric Company, Cleveland, Ohio, or its field representatives.

▲ Peabody Engineering Corporation, of New York, has issued a new bulletin, No. 109, describing the Peabody CD (constant differential) wide range oil burning system. It explains how the system achieves efficient combustion over a range in capacity as great as 50 to 1, controlling any number of Peabody burners throughout all variations in capacity. A copy of this bulletin will be sent free on request.

▲ A 16-page bulletin No. 26, just published by Ajax Electrothermic Corp., Trenton 5, New Jersey, describes high-speed, precision melting of non-ferrous metals in Ajax-Northrup induction furnaces. Both lift-coil and tilting-coil types of furnaces are illustrated and fully described, in sizes from 120 lb capacity up, powered by efficient motor generator units from 50 kw up. Smaller furnaces are described in other bulletins. Of particular value are helpful hints in planning an efficient foundry, and a table showing proper equipment to maintain any given production schedule with red brass, copper, yellow brass, aluminum, magnesium, gold or silver.

▲ A proposed Simplified Practice Recommendation for Hard Edge, Flexible Back, Metal Cutting Band Saws has been submitted to producers, distributors, and users, for acceptance or comment, according to an announcement of the Division of Simplified Practice of the National Bureau of Standards.

The proposed recommendation, which was developed in cooperation with the industry contemplates the establishment of a voluntary simplified list of regular type and skip-tooth type of hard edge, flexible back, metal cutting band saws. It is believed that the proposal will meet all regular requirements.

Mimeographed copies of the proposed recommendation may be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington 25, District of Columbia.

▲ A new 8-page booklet titled "Fine Wire of Special Materials" has been announced by North American Philips Company, Inc., 100 East 42nd Street, New York.

The text material was written by Robert L. Zahour, technical-commercial manager of the company's wire division, and brings the reader up to date on manufacturing methods and problems connected with wires 0.002 in. to 0.0007 in. diameters and smaller.

Among the subjects treated are:

1. Important steps in producing a good diamond die.
2. Drawing the wire.
3. Methods for checking diameter, elongation, tensile strength and ohmic resistance.
4. X-ray diffraction examination of atomic structure.

The booklet contains ten photos which make the text easy to understand.

▲ The DeVlieg Machine Company, 450 Fair Avenue, Ferndale, Michigan, now have available for distribution an eight-page bulletin describing the new model 3-B Jigmil. This new type boring and milling machine introduces automatic positioning and accuracy beyond human skill with unique push button controls. All bar functions can be performed with the operator's continual visual attention to the cutting tool.

▲ A four page pamphlet, called Cellular Rubber 845-21, describes various forms in which sponge rubber, bonded fibre and other sub-density materials are manufactured. It illustrates ninety-eight molded, die cut and fabricated shapes of flexible, elastic compressible products used for cushioning, shock absorption, vibration dampening, sealing, insulating, gasketing, etc. The booklet may be obtained from the Sponge Rubber Products Company, Derby Place, Shelton, Connecticut.

▲ An attractive two-color leaflet has just been issued by The Brush Beryllium Company, 3714 Chester Avenue, Cleveland 14, Ohio, to give comprehensive information on the advantages and applications of beryllium. Many illustrations are used in this two-color folder to cover the wide field of uses for these products. A unique cover dramatizes the atom of beryllium. Of simple atomic structure, it is the only light metal with a high melting point, and provides superior advantages for X-ray transmission and sound velocity.

No longer under allocation, beryllium copper alloys are available promptly as ingots, shot or powders. They are also available as rods, strip, sheet and wire and in the form of castings and various shapes.

Also described extensively are beryllium metal, beryllium aluminum alloys, beryllium nickel alloys and special beryllium alloys, as well as beryllium oxide as a high temperature refractory.

Copies of this leaflet may be obtained from The Brush Beryllium Company.

▲ "Simplified Design of Structural Steel," by Professor Harry Parker of the University of Pennsylvania, is the fourth of a series of elementary books dealing with the design of structural members used in construction. The present volume treats of the design of the most common structural steel members that occur in buildings. The author has endeavored to show how the application of the basic principles of mechanics simplifies the problem and leads directly to a solution. The text has been arranged for use in the classroom as well as for home study. Tables essential to structural engineering have been included so that no additional reference books are required. The book is published by John Wiley & Sons, Inc., New York.

N·B·M BRONZE AND COPPER RESEARCH EASES THE BIRTH OF BETTER STEEL

Here in the N-B-M metallurgical and engineering laboratories we are constantly working to make *your* job easier: seeking improved bronze and copper alloys more resistant to the heat and pressure of flaming furnaces, roaring mills.

From this research have come such important advancements as the famed N-B-M #200 Bronze Mill Roll Bearings that give 8 to 18 times longer service—heat-defying tuyeres—tougher blast furnace copper castings and many others.

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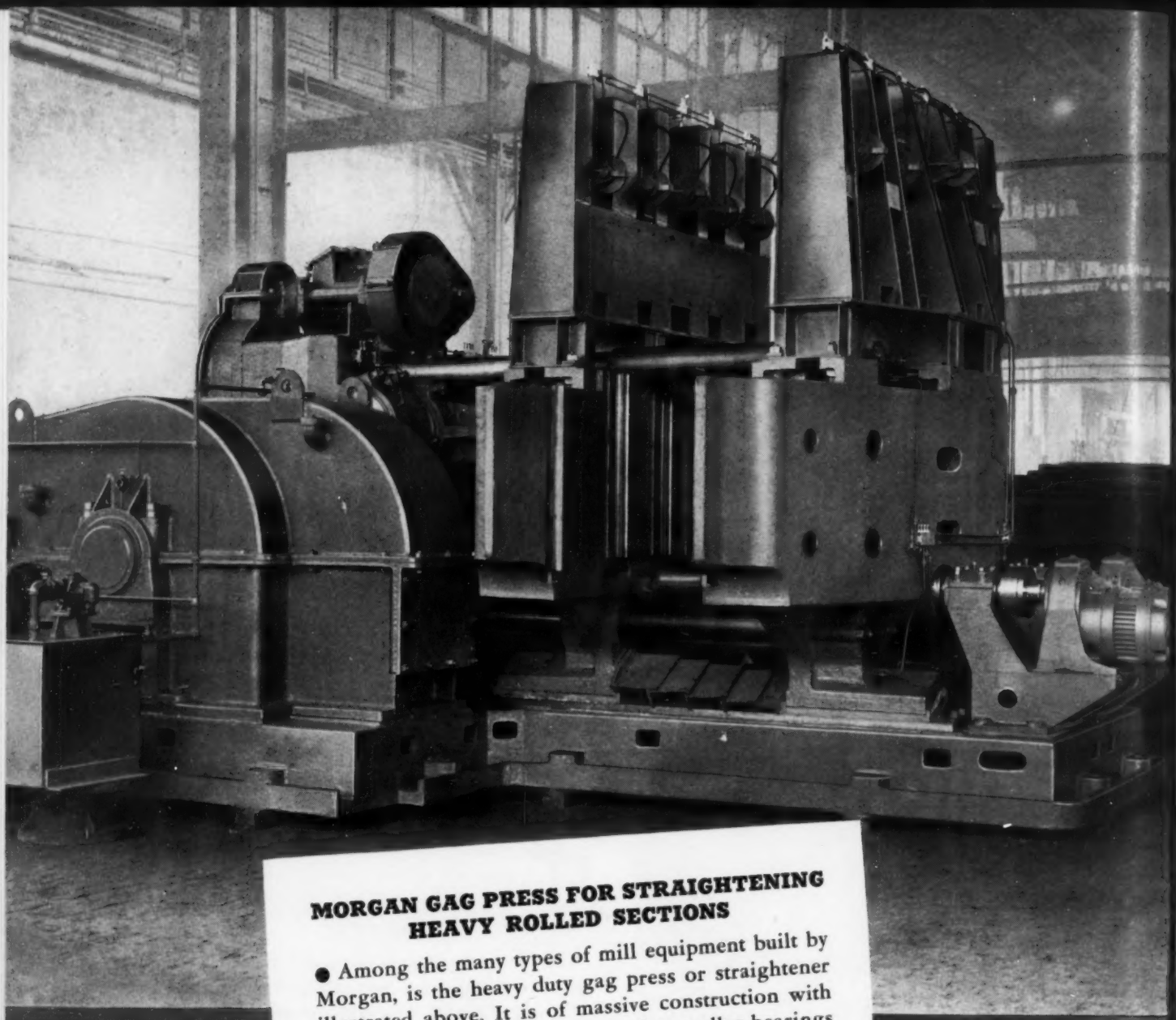


MORGAN GAG PRESS FOR STRAIGHTENING HEAVY ROLLED SECTIONS

● Among the many types of mill equipment built by Morgan, is the heavy duty gag press or straightener illustrated above. It is of massive construction with drive gears and flywheel mounted on roller bearings and all enclosed in an oil-tight welded housing. All anvil blocks are raised and lowered by individual air cylinders. The two feed rollers are driven by individual motors. This press is typical of the many types of Morgan mill equipment

BUILT BY MORGAN Engineering

THE MORGAN ENGINEERING CO.

ALLIANCE, OHIO. 1420 Oliver Building, Pittsburgh

DESIGNERS • MANUFACTURERS • CONTRACTORS • BLOOMING MILLS • PLATE MILLS STRUCTURAL MILLS • ELECTRIC TRAVELING CRANES • CHARGING MACHINES • INGOT STRIPPING MACHINES • SOAKING PIT CRANES • ELECTRIC WELDED FABRICATION • LADLE CRANES • STEAM HAMMERS • STEAM HYDRAULIC FORGING PRESSES • SPECIAL MACHINERY FOR STEEL MILLS

Personnel News

H. K. Wilson has been appointed superintendent of the Bethlehem Steel Company's sheet and strip mill to succeed the late John Miller. Mr. Wilson was formerly superintendent of the mechanical department. **Henry R. Turner** succeeds Mr. Wilson as superintendent of the mechanical department. He had been general master mechanic at the sheet and strip mill.

A graduate of Annapolis, class of 1924, Mr. Wilson was employed at the Lackawanna plant for a short time after leaving the Naval Academy. He returned to the company in 1930 as mechanical foreman in the blast furnace department and later was made assistant superintendent of the strip mill. He was born in Illinois in 1901.

Mr. Turner, a graduate of Catholic University, Washington, first was employed by Bethlehem in 1923 as a shop man. Later he was made assistant to the electrical superintendent and subsequently was promoted to general master mechanic at the strip mill.

HOWARD SPENCER

Howard Spencer has recently joined the Salem Engineering Company organization. Mr. Spencer is a steel mill furnace engineer of long experience. After attending Carnegie Tech, he became associated with Chapman Stein, Rust Engineering, Amsler-Morton, Loftus Engineering, and Spencer Furnace companies.

Mr. Spencer is now in England visiting the Salem Engineering Company's office.

Bert Hall, manager of Salem Engineering Company's Canadian office, located in Toronto, is also visiting the Salem Engineering Company office in England.

Harold J. Thompson has been appointed district manager of the Reliance Electric and Engineering Company in Gary, Indiana, according to an announcement by R. O. Herbig, Central Western sales manager.

Mr. Thompson will serve the industries of the Calumet and Northern Indiana districts, and will make his headquarters in the Gary National Bank Building.

A graduate of Purdue University in Electrical Engineering, Thompson has been with the company since 1926. First occupied in production engineering at the Cleveland plant, he has since 1935 specialized in the application of motor drives to steel mill equipment in the Northern Ohio area.

ARTHUR R. TOFTE

Arthur R. Tofte has been named manager of the advertising and public relations department, Allis-Chalmers Manufacturing Company.

Mr. Tofte has been a member of the department since 1938. He succeeds **George J. Callos,** who resigned to become vice president and account executive for a Milwaukee advertising agency.

The new manager entered the department as copy chief. He became director of employe publications in 1942 and held that position until he was selected to head the department.

E. G. Schlup was recently promoted to chief electrical engineer, general engineering department, American Rolling Mill Company, Middletown, Ohio. Mr. Schlup is a member of the A. I. S. E.

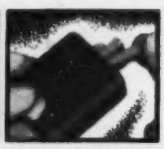
M. I. Arms is the new board chairman and executive vice president of Taylor-Wilson Manufacturing Company, McKees Rocks, Pennsylvania, following purchase of its control by the Arms-Franklin Corporation, Youngstown, Ohio. Other officers elected include H. M. Wilson, president; J. A. McColm, Jr., treasurer and assistant secretary; and O. A. Christiansen, secretary and assistant treasurer.

R. E. Walsh has been appointed assistant manager of the roll department of Continental Foundry and Machine Company.

Mr. Walsh, who was educated in Chicago and is a graduate of the University of Chicago, joined the Continental organization in 1936 and spent 7 years in various capacities in the roll foundry before joining Continental's sales organization. Mr. Walsh will make his headquarters at the Chicago Works of Continental which is located in East Chicago, Indiana.

FOR *Fast Interchangeable*
STAMPING!

MATTHEWS *"Champion"* HOLDER



Matthews "Champion" Steel Type Holders are used for 90% of all marking applications requiring long, continuous, hard usage. Illustrations left show construction and easy type change. Carried in stock. Write for Catalog 146-A.

JAS. H. MATTHEWS & CO.

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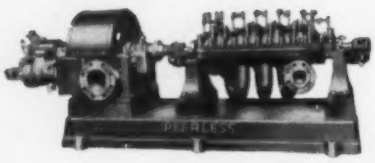
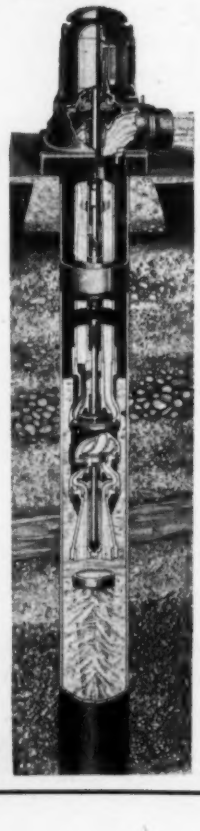
BRANCH PLANTS
NEW YORK, BOSTON, CHICAGO, PHILADELPHIA, NEWARK, SYRACUSE
District Sales Offices: Cleveland, Hartford, Birmingham

YOUR CHOICE OF PUMPS

Horizontal or Vertical





Peerless now manufactures both Horizontal and Vertical types of pumps. Horizontal Pumps are for all manner of service — boiler feed as illustrated above, Underwriters Fire pumps and general service. Vertical Turbine Pumps for deep or shallow wells, oil or water-lubricated. Capacities: 10 to 220,000 gallons per minute.

PEERLESS PUMP DIVISION
Food Machinery Corp.
Factories: Los Angeles 31, Calif., Quincy, Ill. and Canton, Ohio

★ WATER OR OIL LUBRICATION
Peerless

Marshall B. Taft, formerly of the Aero Division, Minneapolis-Honeywell Regulator Company, has been made assistant to **Henry F. Dever,** president of the Brown Instrument Company, Philadelphia industrial division of the Honeywell organization.

Mr. Taft was for three years administrative assistant to the vice president of the Aero Division in Chicago. Prior to that time he was practicing law in Minneapolis. He is a graduate of the University of Minnesota.

G. V. WOODY

G. V. Woody has been named to succeed **R. C. Newhouse** as manager of the Allis-Chalmers basic industries department, with headquarters in Milwaukee, Wisconsin. Mr. Newhouse, who will be retained as a consulting engineer, retires after more than 40 years of service as engineer, inventor and designer of some of the world's largest cement and mining machinery.

Mr. Woody has been manager of the Allis-Chalmers district office at Pittsburgh since 1934, although in 1941 and 1942 he served as administrator of the company's priorities management organization in Milwaukee. Coming to Allis-Chalmers in 1909 after graduating from Rose Polytechnic, he was engineer-in-charge of the centrifugal pump section from 1912 to 1919. He then operated an Allis-Chalmers agency for a year before returning as manager of the Allis-Chalmers Wilkes-Barre office from 1920 to 1926.

R. N. Landreth has been appointed assistant to the vice president of the general machinery division of the Allis-Chalmers Manufacturing Company. Mr. Landreth, who has been special representative for the company, will continue to reside in Washington, D. C., and will function on assignments from Milwaukee.

Associated with the American Brown-Boveri Electric Corporation when it was acquired by Allis-Chalmers in 1931, he joined the Allis-Chalmers organization to serve in the Milwaukee sales office and the electrical department. In 1934 he was transferred to Washington, D. C., and was district manager when appointed special representative in 1944.

Emil Kern has been appointed chief mechanical engineer of all rolling mills and auxiliary equipment of Reynolds Metals Company. Mr. Kern will be attached

to the Central Engineering Division with headquarters in Richmond, Virginia. He was formerly with Mesta Machine Company.

R. T. Klempay, formerly with The McKay Machine Company, Youngstown, Ohio, has been appointed assistant chief engineer of The Arms-Franklin Corporation, and **A. E. Balke,** formerly with The Youngstown Foundry and Machine Company and The Continental Foundry and Machine Company, was made industrial engineer.

W. A. Elliott was elected president of the Elliott Company, Jeannette, Pennsylvania. Mr. Elliott has been executive vice president. Mr. Shipley, who remains as chairman of the board, previously was also president.

F. H. Stohr, formerly assistant to the president, was elected executive vice president and **F. W. Dohring,** who has been general sales manager, was elected vice president in charge of sales.

Other executive officers of Elliott Company include R. W. Owens, vice president in charge of manufacturing, R. B. Smith, vice president in charge of engineering, Dundas Peacock, controller, and M. G. Shevchik, secretary and treasurer.

T. E. McBRIDE

T. E. McBride has been elected president of the Cochrane Corporation of Philadelphia and the following men were named as vice presidents: C. E. Joos, apparatus division, V. A. Rohlin, works manager, A. E. Kittredge, chief engineer and E. S. Daugherty, heater division. The board of directors includes H. E. Sibson, for many years the company's general sales manager and W. V. Sauter of Philadelphia. The corporation has been acquired by these men, long associated with it, who will manage and operate it. There will be no change in the widely-known Cochrane line or sales policies, nor in the nation-wide sales representation of the company. An aggressive program of development and research is planned to maintain the company's leading position in its field.

C. E. Lehr, chief engineer, Bethlehem plant, Bethlehem Steel Company, has retired after 54 years of service with the company and its predecessor, Bethlehem Iron Company. Mr. Lehr's retirement was effective October 1. Mr. Lehr entered the employ of the Bethlehem Iron

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METAL CUTTING & TRIMMING COSTS FROM DOLLARS TO PENNIES

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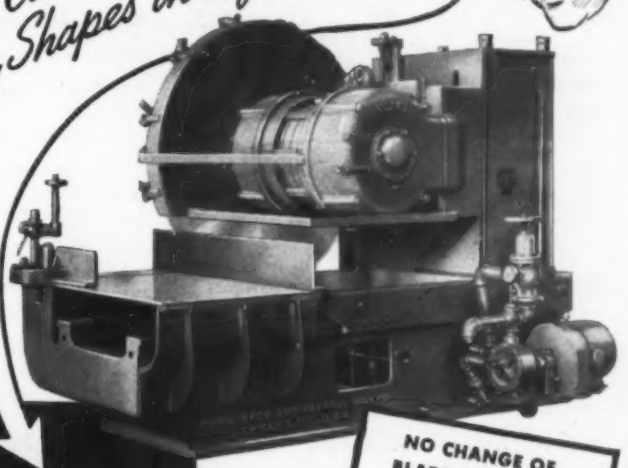

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15" 55# CHANNEL 15 SECONDS

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9 SECONDS 100# A.R.A. RAIL

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15 SECONDS 4" ROUND

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CUTS ALL CLASSES OF STEEL - QUICKLY AND ECONOMICALLY

The versatile ability of the Kling Friction Saw to cut varied structural shapes in any sequence, without change of blade or set-up, permits one machine to handle various types of work which, otherwise, would require several slow speed saws to handle.

The installation of a Kling Friction Saw will quickly convince you of its superiority and advantages over the old type of saw. Furthermore, you will cut your cutting costs — savings will be effected in time and labor because of speed and efficiency of the Kling Saw.

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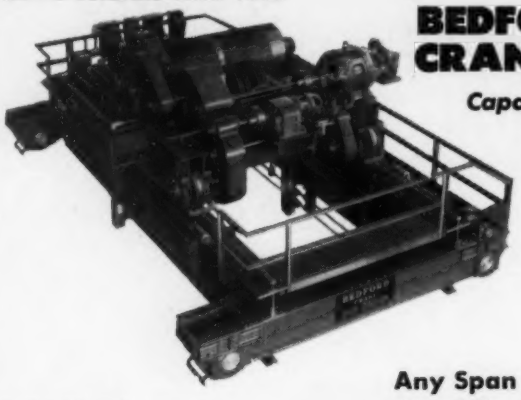

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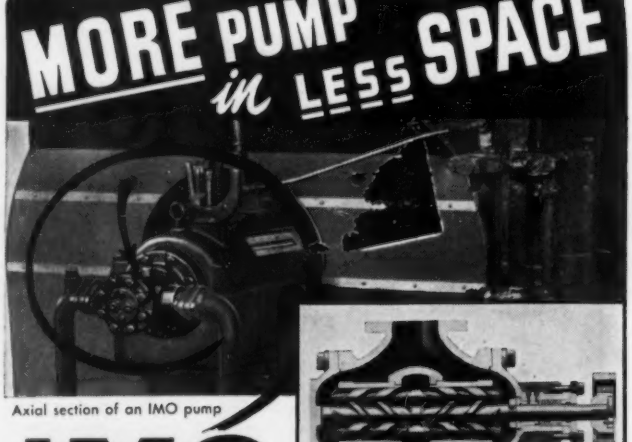
Gray Iron Castings

MORE PUMP in LESS SPACE



Axial section of an IMO pump

IMO

Lubrication oil pump directly connected to shaft of steam turbine.

The IMO pump provides "more pump in less space" because it can be operated at high speeds and correspondingly high capacities, directly connected to and integrally mounted upon motors, turbines or other driving machinery—without the necessity of speed reduction gears.

For further information write for Catalog I-126-1

IMO

PUMP DIVISION OF THE
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

Company in 1891 and advanced rapidly to melter, but had hardly attained that position when an injury incapacitated him from further physical activity for some time. He studied engineering at home and, in 1901, entered the plant engineering department as a draftsman.

In 1903 he became a squad leader and from then he moved steadily forward in responsibility, participating in the engineering work in connection with the development of the plant. He became chief engineer in 1909 and was placed in charge of all construction and engineering work, including expansion activities during World War I and the construction of the Bethlehem Loading Company facilities at Redington.

John A. Taylor, superintendent of the Lower Manufacturing Shops succeeds Mr. Lehr as chief engineer. Mr. Taylor is a graduate of McGill University, Montreal, Canada, in chemical engineering. He started with Bethlehem as a "looper" immediately upon graduation in 1924. Upon completion of his loop training he became a slagger in No. 2 Open Hearth. On February 15, 1925 he was made combustion engineer in the Saucon mechanical department.

Subsequently he became boiler foreman, chief metallurgical observer in No. 2 Open Hearth and, in 1931, turn assistant superintendent in the same department. In 1932 he was made general foreman Metallurgical Division, and later was made assistant superintendent, of Forge Specialty. In 1938 Mr. Taylor was advanced to superintendent of Forge Specialty and, on January 9, 1942, superintendent of the Lower Manufacturing Shops, which comprise Forge Specialty and Nos. 4 and 5 forges, built to handle expanded wartime production.

James A. Bell, assistant to the chief engineer, becomes assistant chief engineer. Mr. Bell has been with Bethlehem Steel since 1906, when he entered the engineering department as an apprentice draftsman. He became a designer in 1910 and in 1915 was instrumental in designing and supervising the construction of the 42-inch shape mill in the Saucon division. During 1917 and 1918 Mr. Bell served with the U. S. Army, returning to Bethlehem Steel in 1919. In 1934 he designed and installed at the Lackawanna, New York, plant the first overhead electrically operated manipulator. He was made chief draftsman in the engineering department in 1939 and in August of this year was appointed to chief engineer.

W. H. Henry, former manager of General Electric's motor division, has been appointed assistant manager of the industrial divisions in charge of motors. This shift is one of a series in the reorganization of the motor division which, in view of the large volume of electric motor business, and the advisability of segregating it into a natural arrangement of operating units, is now separated into four divisions and one section. The following Division managers have been appointed: **A. W. Bartling,** manager fractional-hp motor division; **Elliott Harrington,** manager induction motor division; **J. T. Farrell,** manager d-c motor division; and **P. A. McTerney,** manager synchronous, large d-c, and gear-motor division.

E. A. Green, who during the war has been on war manufacturing assignments, returns to the motor organization as general assistant to Mr. Henry. **D. E. Moorhead,** recently returned from the armed forces, is appointed assistant to Mr. Henry to give particular attention to motor sales activities. **O. F. Vea** continues in charge of the motor marketing and promotion section, and **A. A. Merrill** continues in charge of forecasting, order budgets and statistics group for all motor lines.

DAVID F. AUSTIN

David F. Austin was recently elected sales vice president, United States Steel Corporation of Delaware. Mr. Austin has been acting vice president since June 20, 1945, during which time he continued as vice president in charge of sales, Carnegie-Illinois Steel Corporation.

He began his career with United States Steel as an office boy in the corporation's New York office late in 1918, served in various capacities with the real estate department of the Carnegie Steel Company until 1927 when he was transferred to the sales department, entering the company's sales school. After working as a salesman in four different sales territories, he was advanced to assistant district manager of sales, Cincinnati. Subsequently, he served successively as district manager of sales in Cincinnati, Pittsburgh and Chicago.

Mr. Austin was elected January 1, 1938, as vice president in charge of sales, Carnegie-Illinois Steel Corporation. He served in this capacity until his current advancement. From January 1942 until July 1943, Mr. Austin served with the War Production Board, becoming successively assistant director, deputy director, and acting director of the board's steel division

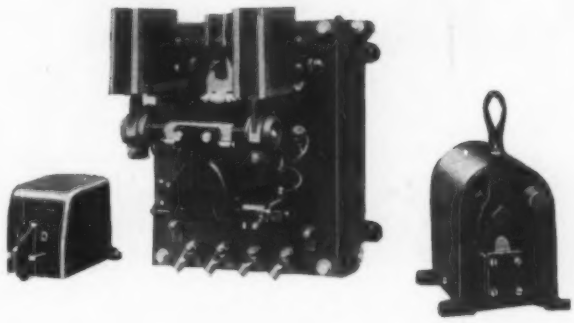
John D. Gordon has been named general manager and **Carl L. Halpin** as manufacturing works manager for Progressive Welder Company, Detroit, Michigan.

Mr. Gordon was formerly general sales manager of Progressive Welder. As general manager, he will be in complete charge of all company operations, including sales, service, manufacturing and engineering, the latter having been expanded by the addition of a welding and welding equipment research and development division.

OHIO

QUICK DROP MAGNET CONTROLLER

With arc suppressor and quick drop, automatic for any class of material.



Two main switches open circuit in series. Reverse and quick drop are automatic. Master contacts carry control circuits only.

The arc suppressor reduces the arc so it is not harmful or disagreeable. Contact tips are thus saved. Arc shields do not burn.

This controller makes possible 6 or more lifts per minute which is as fast operation as any we have ever observed in practice.

●

OHIO reliable MAGNETS

The Ohio Electric Manufacturing Company

5907 Maurice Ave., Cleveland 4, Ohio

G. G. LANDIS

H. F. KNEEN

Mr. Halpin leaves an extensive consultation practice on manufacturing to take over the production management of Progressive's expanded line of resistance welding equipment.

H. F. Kneen has been named vice president in charge of manufacturing, and **G. G. Landis,** vice president in charge of engineering for The Lincoln Electric Company, Cleveland, Ohio. Both men have served the firm for many years, having helped it develop to its position as world's largest producers of arc welding equipment.

Mr. Kneen joined The Lincoln Electric in 1929, a few years after graduating from Cornell University where he received a master's degree in industrial engineering. Promoted from his original position of assistant plant superintendent to general plant superintendent in 1931, he has been largely responsible for carrying out the policies of the company's widely-known incentive plan.

Mr. Landis is a veteran of over 20 years with Lincoln Electric. He received his electrical engineering education at Ohio State University and graduated with a bachelor of science degree in 1922.

After two years with several large electrical companies, he resigned to enter the laboratories of Lincoln Electric in 1924, and was promoted to chief engineer in 1930. Many patents on both arc welding and electric motors have resulted from his genius in the electrical engineering field.

Vice president Landis is a director of the company and has complete charge of the design and production engineering on welding equipment manufactured by the company.

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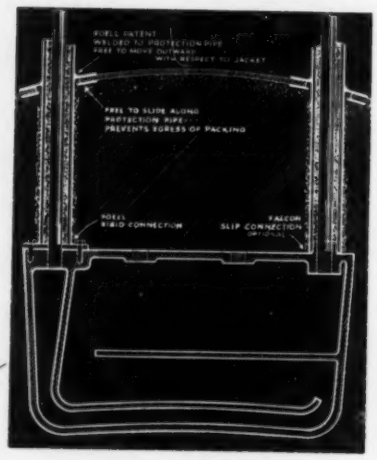
NECKLESS COOLING PLATES

• VERTICALLY CAST WITHOUT ANCHORS OR CHAPLETS

• The advantages of Falcon's "Anchorless" casting method are: 1—sound castings; 2—uniform wall thickness; 3—density of copper at nose, due to vertical casting; 4—freedom from oxide and sand inclusions; 5—absence of blow holes; 6—longer, trouble-free performance.

This Falcon Neckless Cooling Plate with patented Foell jacket attachments is made by the "Anchorless" method.


FREE TO SLIDE ALONG PROTECTION PIPE—PREVENTS FORCES OF PACKING
FOELL STUD CONNECTION
FALCON SLIP CONNECTION (OPTIONAL)

Made with feed and discharge adjacent or at opposite ends of plate.

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TELEPHONE COLLECT 34355

FALCON BRONZE CO.
YOUNGSTOWN 3, OHIO
Established 1890 . . . Incorporated 1895

Obituaries

John S. Delaney, one of the A. I. S. E. "Old Timers" and a Life Member died on October 5th.

Mr. Delaney was born October 18, 1876 in Buffalo, New York. On June 1, 1896, he entered the employ of the Granite City Steel Company at Granite City, Illinois and soon rose to the position of chief electrician, which he most capably filled for over forty years. He would have rounded out fifty years of service with this same company in 1946.

Earl B. Beach, who established and owned the E. B. Beach Company, suppliers of electrical materials, died October 20, 1945. Mr. Beach was born in Pittsburgh. He was a member of the Association of Iron and Steel Engineers, the Civic Engineers Club, and many other organizations.

LINK-BELT *Silverstreak*

Five years ago Link-Belt Silverstreak silent chain replaced another type of drive on this high speed drive and as a result of making this change, the silent chain drive has given uninterrupted trouble-free service. Starting torque reaches 300% normal load.

SILENT CHAIN DRIVES HELP BOOST PRODUCTION OF *Wire Rope!*

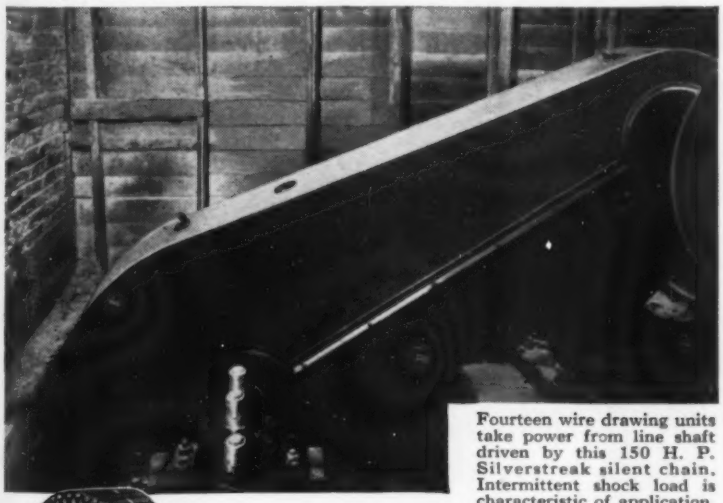
EFFICIENCY and RELIABILITY STRIKINGLY DEMONSTRATED

War at sea and in the air required vast amounts of wire rope, for numerous purposes. As the tempo of the conflict increased, makers of wire rope were called on for "more rope—better rope—more kinds of rope, than had ever been made before!"

In the "E" plant of the Macwhyte Company, energy and ingenuity combined were exerted to meet this call, with noteworthy results. Methods and machines were developed and improved, largely by their own engineering department, which stepped up the volume to meet the Navy's demand for an utterly dependable product.

On every type of machine, throughout the plant, power is delivered by positive, efficient Link-Belt Silverstreak silent chain drives. A few typical applications, with pertinent data, are illustrated. These drives are demonstrating the economy and efficiency inherent in the design and assured by the precision manufacture of Link-Belt Silverstreak silent chain drives.

Engineers—superintendents: send for Data Book 125, packed with helpful facts and application suggestions.



Fourteen wire drawing units take power from line shaft driven by this 150 H. P. Silverstreak silent chain. Intermittent shock load is characteristic of application. Drive has operated continuously for 21 years, with no upkeep expense.

Eliminate Slip

PUT TEETH IN YOUR DRIVES

LINK-BELT COMPANY

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LINK-BELT *Silverstreak* **SILENT CHAIN DRIVE**

Let's say a word for

Mr. X

Mr. X is vitally concerned in improving the quality and output of his mill's production and in reducing operating costs. . . .
HE'S THE MILL SUPERINTENDENT.

And when he suggests that G-E Textolite roll-neck bearings should be installed to help realize these improvements, we think his recommendation should be adopted. . . . So let US say a word for Mr. X.

Quality of production depends a lot on roll-neck bearings. Since Textolite wears away so very slowly, the infrequency of mill adjustments facilitates the holding of gauge.

As for output, Textolite stands up so well its replacement involves a minimum of shutdowns. . . . Production keeps up. And minimum loss of power, due to friction, permits highest possible mill speeds with maximum reduction per pass.

Relying solely on water for lubrication, there is a 100 per cent saving in grease. And the great savings in power consumption tops the list of economies that are possible with Textolite.

Our experienced bearing engineers are ready to help you put Textolite bearings in your mill.

For information, write Section W-72, General Electric Company, Plastics Divisions, One Plastics Avenue, Pittsfield, Mass.

GENERAL ELECTRIC
PD-72

Even OLD MAN WEATHER didn't hurt these B&W IFB!

In the spring of 1942, eleven heat-treating furnaces, lined with B&W Insulating Firebrick, were moved outside an automobile plant to make room for war production. For three years they weathered summer rains and winter storms—with nothing for protection but a tarpaulin.

Reconversion brought them back into the plant. There was apparently no refractory deterioration—either from exposure to weather or from stresses incurred in moving.

The furnaces were started up, and in spite of the unusual weather treatment to which they had been subjected, have already operated for three months without any indication that the B&W Insulating Firebrick were in any way affected.

The story told above is typical — it proves that you can count on the durability of B&W IFB, in combination with their light weight and low heat conductivity to serve you faithfully in your plant.

B&W Insulating Firebrick have the lightest weight and lowest heat conductivity of any refractory in their class. Where B&W IFB have been installed, substantial savings in maintenance and fuel have been realized. See your local B&W Refractories Engineer about using these cost-cutting firebrick in your furnace installation.

R-227

B&W

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

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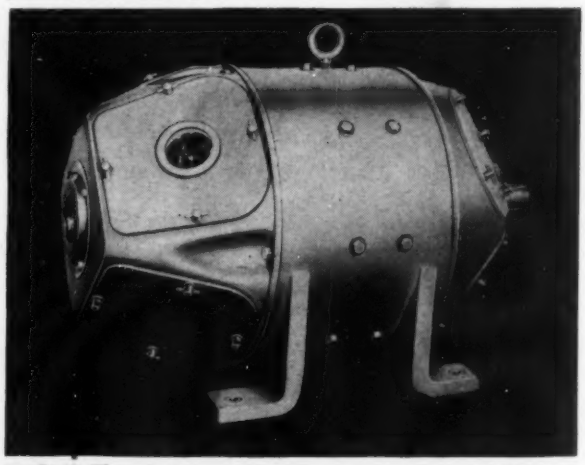
1925 This Electro Dynamic motor was salvaged from the Submarine S-51, after 9½ months immersion in sea water. With a high pressure hosing and a drying period, it was found to run immediately at full load. This practical salt water test, one of the most severe for an insulating varnish, failed to break down the insulation on the CHINALAK protected windings.



1945 Today, as twenty years ago, the Electro Dynamic Works of the Electric Boat Company is still producing electric motors for service in our Merchant and Naval vessels. We are proud to say that the windings of these motors are still CHINALAK protected.

TIME-PROVEN AND TESTED for over 30 years, CHINALAK Baking Varnishes still possess certain properties that have not been equalled or surpassed.

Listed below are some of the more important features of this product . . . worthwhile facts that have established CHINALAK's excellent reputation:

COLOR: Available in both clear and black.

RESISTANCE: Affords maximum resistance to oil, water, acids, alkalies and chemical fumes.

BAKING TIME: Adaptable to your own specific application. Very satisfactory results obtained at both high or low temperatures.

FLEXIBILITY: The finish provided by this material is extremely flexible and affords dependable, lasting protection to windings where any appreciable expansion or contraction takes place. Minimizes the cracking and breaking of leads.

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WRITE TODAY for further information on these moderately priced varnishes. With the data requested, we will also send you free, a booklet entitled "Salvaging of the United States Submarine S-51."

Insulating Dolph's *Varnish Specialists*

JOHN C. DOLPH COMPANY

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give you . . .

. . . subdue troublesome motors and generators

Having trouble getting at the root of brush troubles on d-c and slip-ring motors and generators—sparking, overheating, burning, energy losses? Maybe the brushes are "misfits."

Switch to SPEER Brushes for *double* assurance of peak performance from any commutating equipment—*double* assurance because every SPEER brush is matched, both mechanically *and* electrically, to the machine it's sold to serve.

Save time. Avoid experiments. SPEER can supply the brushes you need from its all-inclusive line of standard and special carbon, graphite, electro-graphite, and metal-graphite brushes. SPEER has been a recognized specialist in matching brushes to machines for almost 50 years.

So for brushes matched to *your* machines, call on SPEER for experience. Write for Brush Data Forms—a Speer service, no obligation.

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even this motor is efficient now

with KEYSTONE BALL BEARING END BELLS

A direct current motor with so much lubricating oil wasted on it that even the rubber bushings around the lead wires dissolved and the working parts were no better. Rewound, realigned and with KEYSTONE BALL BEARING END BELLS taking the place of sleeve bearings . . . this motor is now returned to service and is operating with an efficiency and economy equalled only when it was new!

The motors in your plant, either A.C. or D.C. — some comparable to this — others not much better, are easily returned to productive, trouble-free service with KEYSTONE BALL BEARING END BELLS. Maintenance costs are greatly reduced for no lubrication is required and no flying oil impairs their efficiency.

KEYSTONE BALL BEARING END BELLS have been designed for nearly all sizes, types and makes of sleeve bearing motors. Call or write for full information on the motors in your plant.

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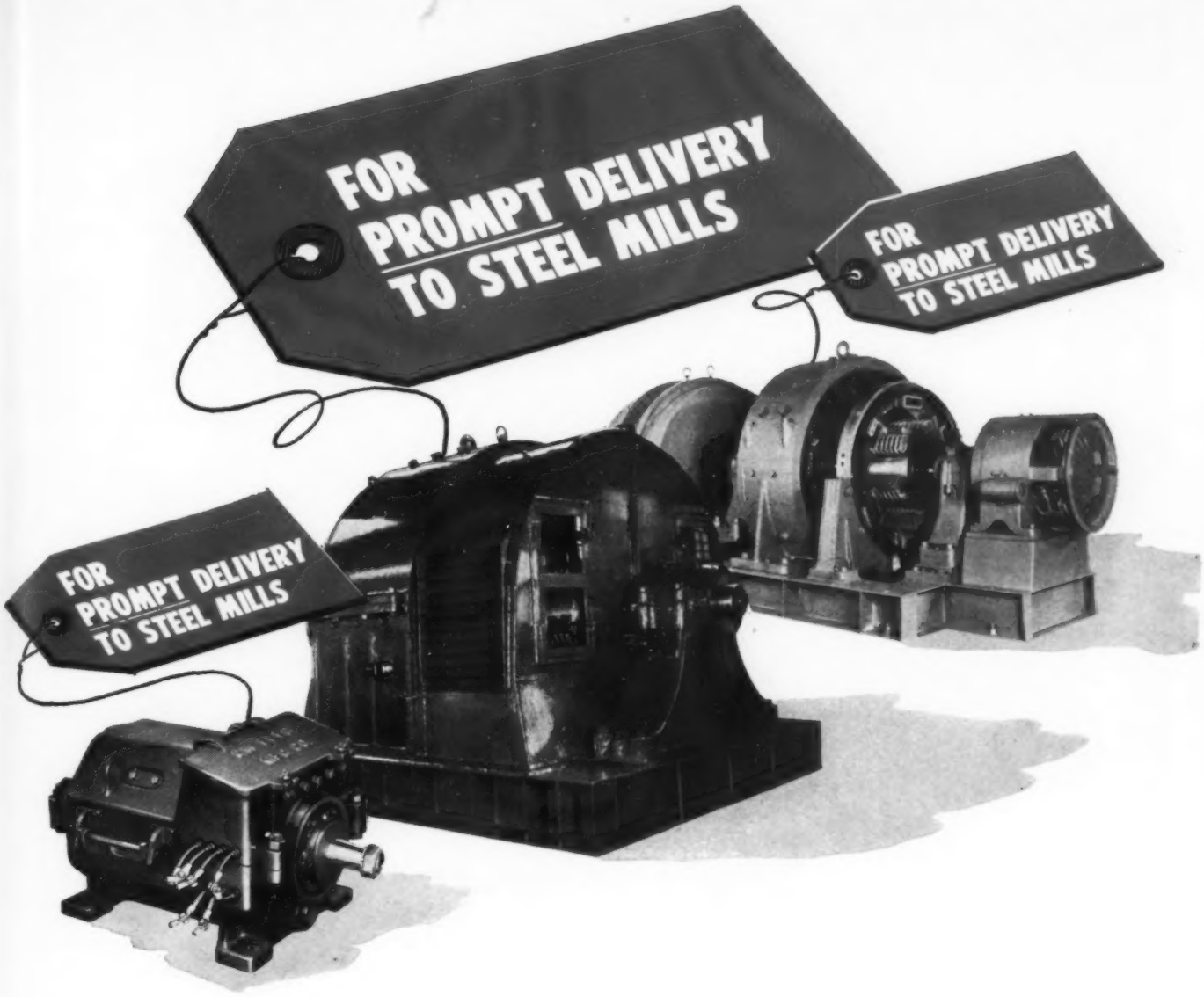

With reconversion completed, the Crocker-Wheeler shops are today in a better position to produce electrical equipment for the steel industry than at any time during the last five years. In fact, where we are able to obtain prompt shipment of the materials used in our equipment, we can promise "better-than-prewar" deliveries on:

1. **Standardized mill motors for auxiliary drives and heavy-duty crane applications**
2. **Direct-current motors in sizes up to 5,000 hp for main roll drives and for slab squeezers, trimming shears, levellers, etc.**
3. **Motor-generator sets to supply power for main motors, auxiliaries, cranes and hoists**

If you are "in the market" for such equipment, send us an inquiry. With your specifications before us, we will be able to tell you exactly how long we will require for design and construction of equipment to meet your exacting needs.

Why not call us today? Your request will immediately place one of our competent field engineers at your disposal—with no obligation, of course.

CW-13

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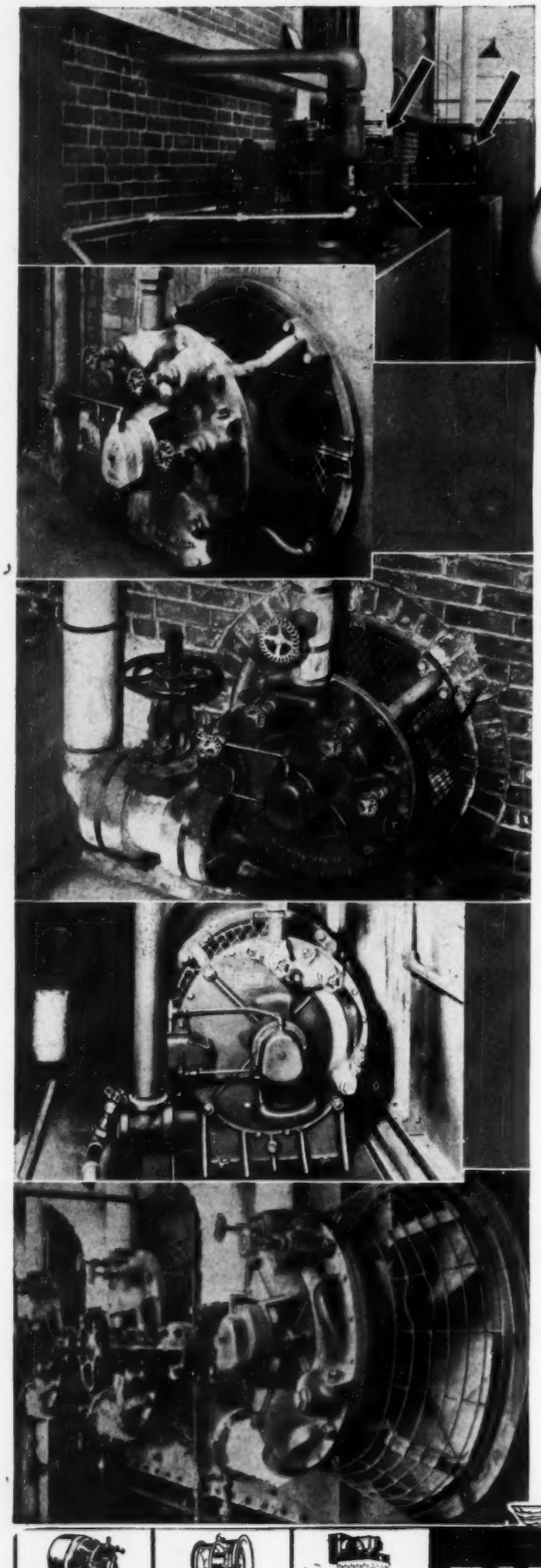
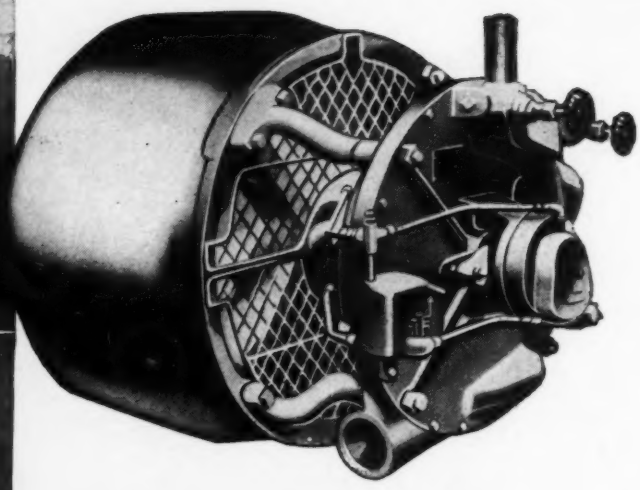
A DIVISION OF JOSHUA HENDY IRON WORKS, AMPERE 20, NEW JERSEY

Branch Offices: BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • LOS ANGELES • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • WASHINGTON





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NO WAITING FOR ELECTRIC MOTORS

WING BLOWERS for Forced Draft are made for motor drive as well as for turbine drive. But the production of electric motors is temporarily one of industry's bottlenecks and motor-driven blowers (Wing's as well as other makes) are subject to greatly deferred deliveries. **WING TURBINE-DRIVEN BLOWERS**, however, are available *NOW*, with all the advantages of the turbine drive in addition. They are compact . . . simple to install . . . quiet in operation . . . and have a unique record for unexcelled reliability and efficient performance. In many plants where use can be made of the oil-free exhaust from these turbo-blowers the operating cost is negligible and the forced draft obtained at minimum cost—vastly lower than motor drive.

Write or wire today.

L. J. Wing Mfg. Co.

142 W. 14th St. New York 11, N. Y.

Factories: Newark, N. J. Made in Canada at Montreal

When others FAIL look to Gatke MOULDED FABRIC BEARINGS

QUALITIES never before AVAILABLE

Amazing! Incredible! Wonderful!—That's what engineers, designers and users say when they see GATKE Bearings do things they had considered impossible.

Time after time, on countless applications, involving all sorts of conditions where everything else had been tried, GATKE Bearings have solved the problem with wonderful results.

These Wonder Bearings have qualities no other bearing can offer. They are engineered for the application and made of correct materials moulded to the required shape and size providing performance qualities and structural characteristics to do the job right. Only GATKE KNOW HOW makes this possible.

Until you've seen GATKE Bearing performance on the actual application you cannot begin to estimate the great advantages they offer.

Send dimensions and service requirements for the GATKE Recommendation or write.

Service Examples

36 times longer service

On a cable armoring machine metal bearings caused practically continuous grief and required almost daily attention. GATKE Bearings average more than three years' service and eliminate journal scoring.

20 times longer service

On mine car axles where metal bearings lasted only 3 months GATKE Bearings average more than 5 years and practically eliminate axle maintenance.

Eliminate galling—improve work

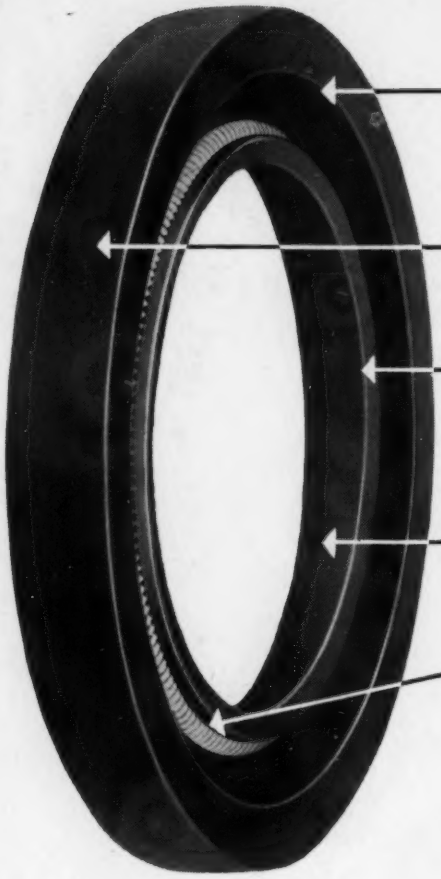
A manufacturer of Milling Machines experienced trouble due to galling of the feed screw Use of GATKE Precision Moulded Feed Screw Nuts stopped the galling and resulted in smoother, more uniform milling. They are giving long service life with minimized wear to the screw. The only lubricant is the coolant used with the milling machine.

GATKE CORPORATION

228 N. LaSalle St., CHICAGO

NEW TYPE *non-metallic* OIL SEAL

offers 3 proved advantages in steel mill service



One-Piece Precision Molded Body—
highly resistant to grease, oil and many corrosive liquids. Entirely non-metallic—can't score.

Rigid Heel—
made of a dense resin-bonded fabric to insure a press fit in the packing recess.

Flexible Lip—
an integral part of the seal. Makes possible accurate control of pressure against shaft by means of self-adjusting garter spring.

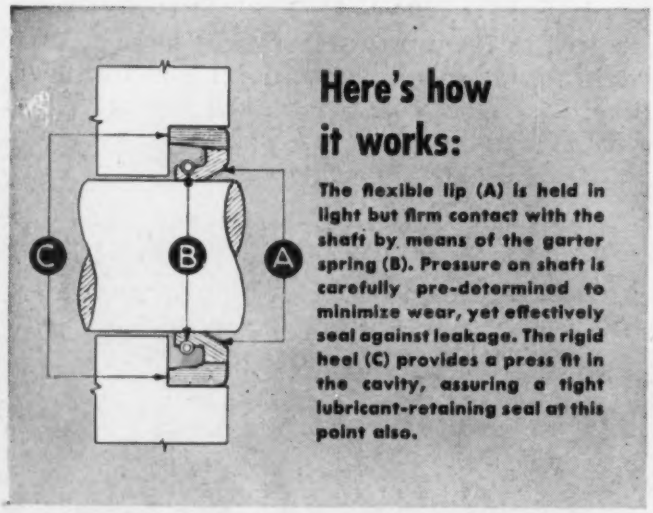
Large Bearing Area—
reduces wear on shaft to a minimum.

Self-Adjusting Garter Spring—
permits accurate control of pressures and provides a positive contact with shaft at all times. Special spring stock is available for extreme corrosive conditions.

THIS new Johns-Manville "Clipper Seal" was designed to do three things: (1) to provide better bearing protection; (2) to minimize wear on the shaft; and (3) to increase the length of service normally expected of an oil-retaining seal.

Users in the steel industry tell us it has made good on all three of these important counts!

A glance at the illustrations shows why. Note Clipper Seal's one-piece body—concentrically molded for a precision fit. Note how the flexible lip is held in light but firm contact with the shaft, effecting a positive lubricant-retaining, dirt-excluding seal—while at the same time reducing wear on the shaft. And note the unusually large bearing area, which further tends to minimize shaft wear.



Here's how it works:

The flexible lip (A) is held in light but firm contact with the shaft by means of the garter spring (B). Pressure on shaft is carefully pre-determined to minimize wear, yet effectively seal against leakage. The rigid heel (C) provides a press fit in the cavity, assuring a tight lubricant-retaining seal at this point also.

Non-metallic in construction, Clipper Seals are highly resistant to most forms of corrosion. Molded of resin-impregnated fabrics and synthetic rubber compounds, they are tough, long-wearing—successfully meet extreme operating conditions. Actual performance experience confirms their ability to outlast other types of bearing protectors in steel mill service.

For further information about Clipper Seals and how they can help reduce bearing maintenance in your plant, write Johns-Manville, 22 East 40th Street, New York 16, N. Y.

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Johns-Manville ***PACKINGS & GASKETS***

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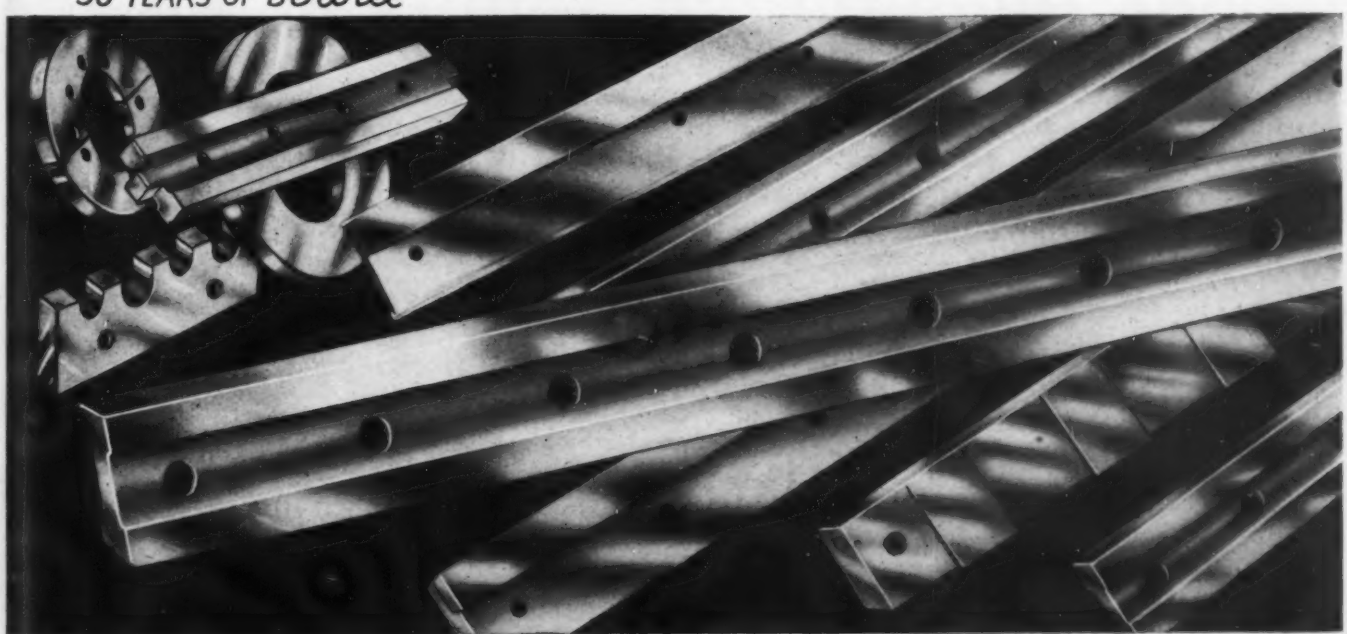

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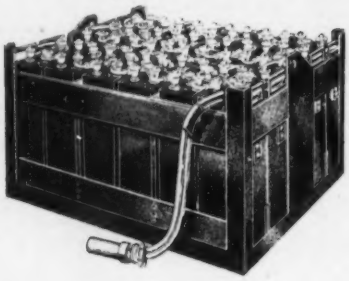

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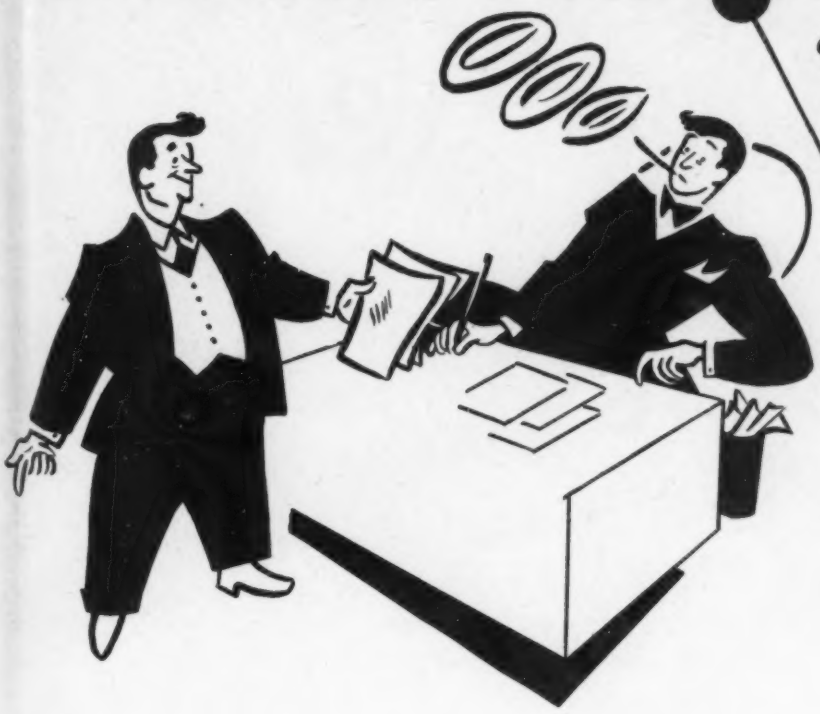

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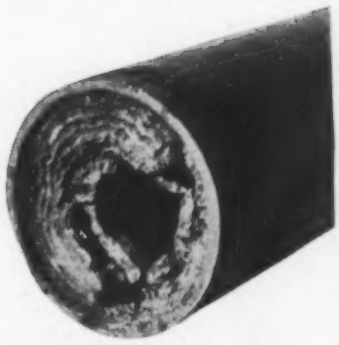

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Paving Breakers are also powerful and light enough for use in breaking clinkers in gas passages and tuyeres; smashing slag; taking out slag pockets; breaking skulls in ladles and hot pots; punching blasting holes in slag piles; tearing out old furnace and converter linings; tamping furnaces; smashing flue dust or clinker sows, etc.

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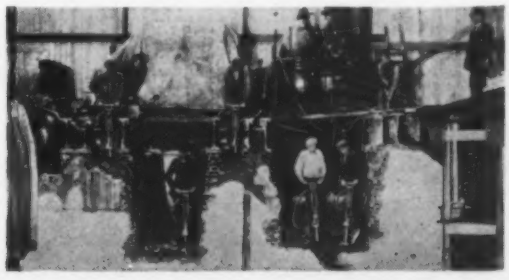

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The Treasury Department acknowledges with appreciation the publication of this message by

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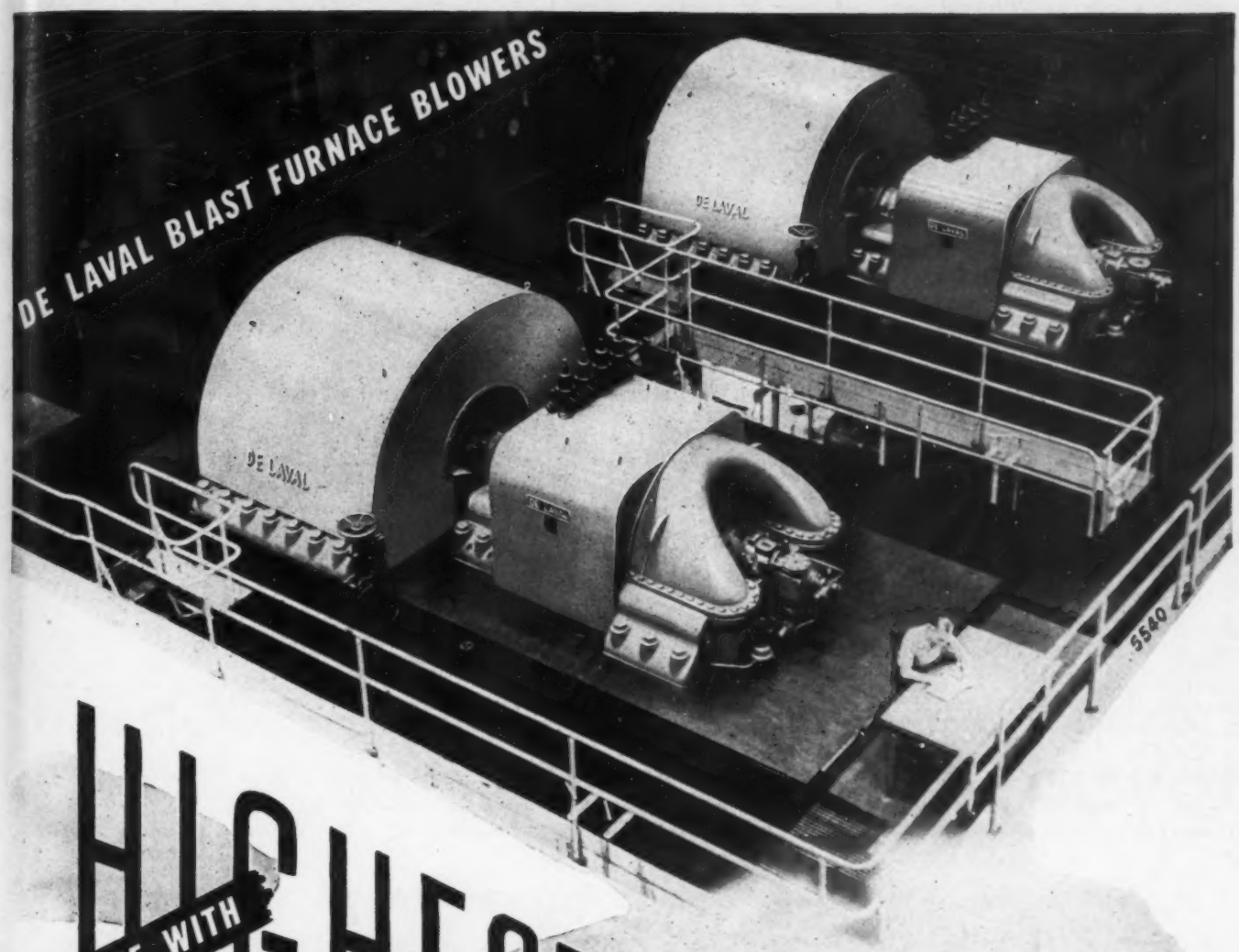

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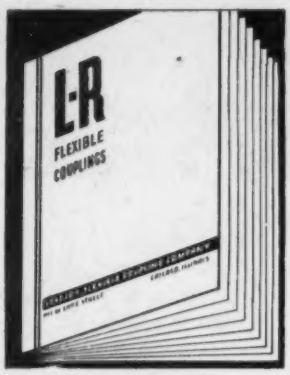

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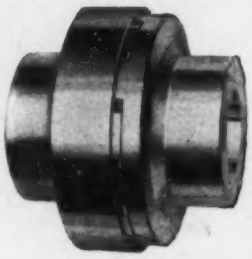

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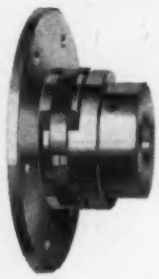

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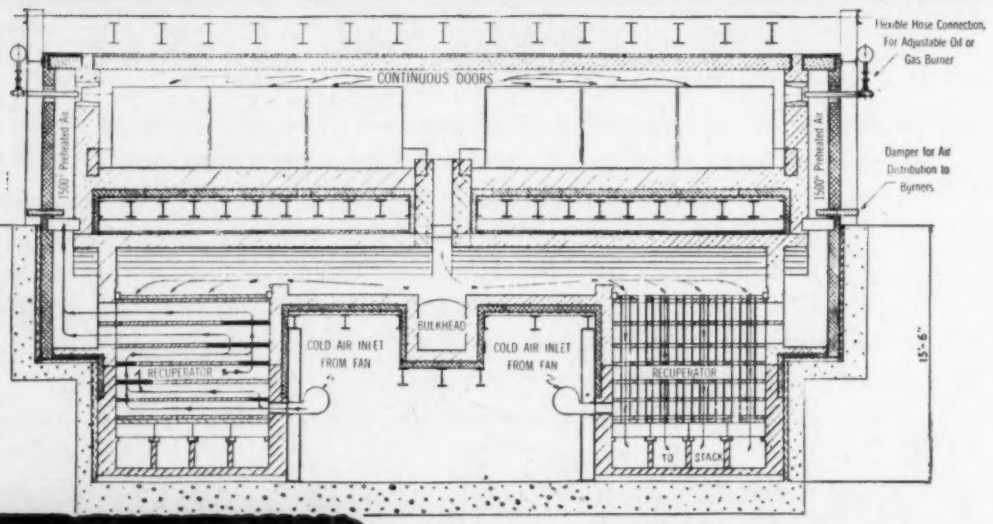

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These special made-for-the-purpose roll neck greases stand up where ordinary greases fall down. The lubricating graphite in them will not squeeze out and is virtually immune to heat. They lessen repairs and replacements. Dixon's Graphited Roll Neck Greases lubricate longer—and reduce power costs. Get them for your roll necks—and any other spot where you fight extreme heats and pressures. Send for folder "ROLL NECK LUBRICATION."

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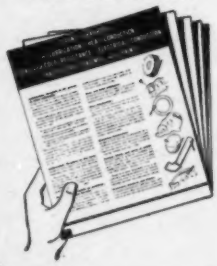

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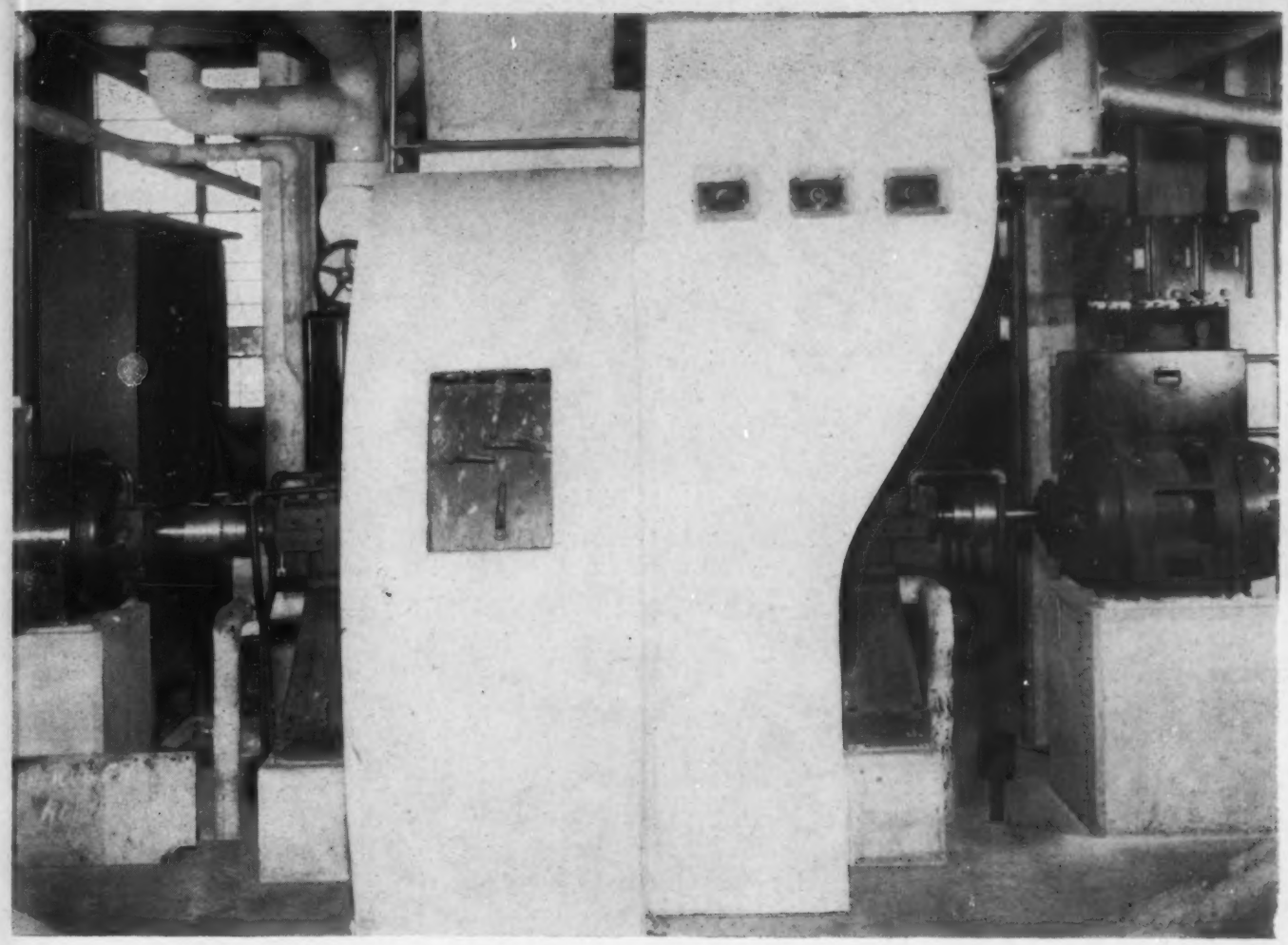

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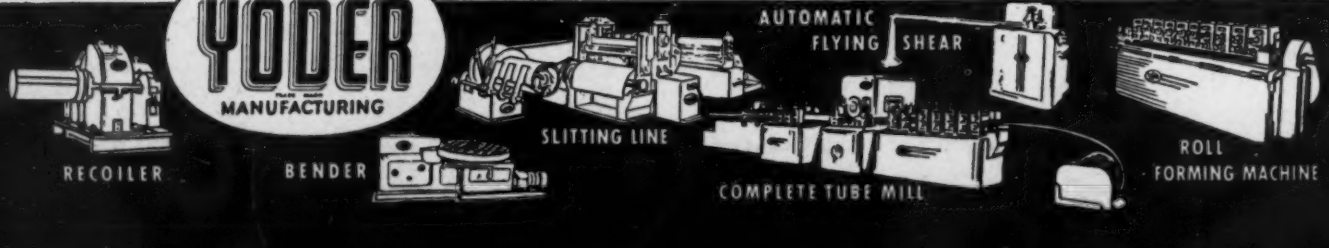

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Youngstown Alloy Casting Corporation 6

IMPACT RESISTING

WHERE service conditions are most severe—where loads are heaviest —where impact, momentary overloads, and vibration are a problem—there NORMA-HOFFMANN PRECISION ROLLER BEARINGS demonstrate their extraordinary ability to absorb punishment.

Short parallel roller design—the use of a heavy-duty, completely machined bronze retainer—extreme refinement of workmanship and finish—these factors combine to give these PRECISION Roller Bearings a lower coefficient of friction under heavy loads than any other type of ball or roller bearing, together with a speed-ability equal to that of any ball bearing, size for size. Write for the Catalog. Let our engineers work with you.

"NORMA-HOFFMANN"

PRECISION BALL, ROLLER and THRUST BEARINGS

NORMA-HOFFMANN BEARINGS CORPN., STAMFORD, CONN. U.S.A.

He Installed Farval to Gain 2 Advantages ... but ended up with 9

Additional Farval Savings:—

3 Save lubricant
4 Save power
5 Save repair costs
6 Increase production
7 Reduce rejections
8 Avoid accidents
9 Make machines last longer

Farval—the Dualine System with the Positive Piston Displacement Valve—that has but 2 Moving Parts—is Fully Adjustable—and with a Tell-tale at each bearing to show the job is done.

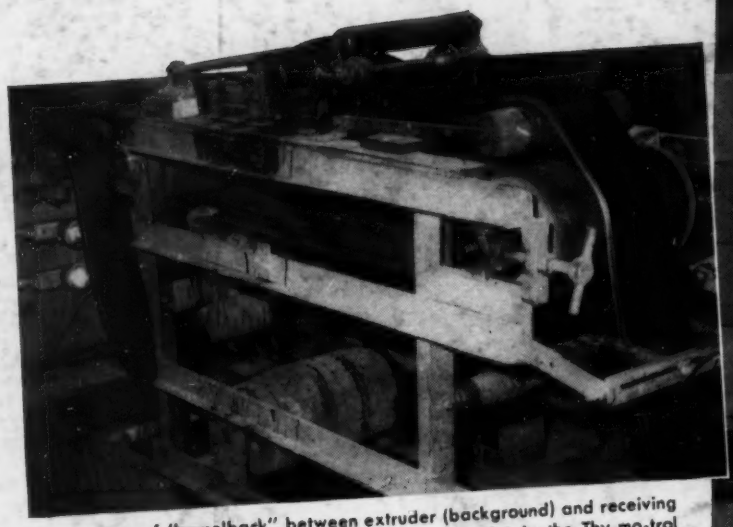
The Works Manager planned—just as you probably have—to install Farval Centralized Systems on all of his machines. He figured that two savings alone would pay a good return on his investment:—

1—Eliminate labor of oiling
2—Cut shutdowns for repairs

But he found his Farval installations gave him the 7 additional savings listed at the left. The 9 totaled enough to pay for his Farval equipment in a few months—leaving future earnings clear gain.

Farval can make your machines earn more, too. Your nearby Farval Representative will gladly survey your equipment, recommend the correct System—and supply complete estimates.

THE FARVAL CORPORATION, 3278 E. 80th St., Cleveland 4, Ohio
Affiliate of the Cleveland Worm & Gear Company, Industrial Worm Gearing
In Canada: Peacock Brothers Limited



A loop of "camelback" between extruder (background) and receiving conveyor actuates a photoelectric control to maintain the Thy-mo-trol driven conveyor at the right speed.

Thy-mo-trol control panel (cover removed), which controls the speed of the d-c conveyor motor.

ELECTRONIC SPEED-MATCHING

of tire-tread machines

helps raise production 100%

Continuous production of "camelback" tire-tread at the plant of W. J. Voit Rubber Corporation, Los Angeles, is now maintained at twice the former rate, using a new speed-matching system which combines a photoelectric control and a G-E Thy-mo-trol drive.

At speeds ranging from 8 to 80 feet per minute, a receiving conveyor is kept in step with an extruder—avoiding "pile-ups" or breaks in the strip between the two machines.

VERSATILE SPEED CONTROL

This arrangement for automatic speed control is typical of dozens of ingenious applications employing Thy-mo-trol drive, on production lines as well as on individual machines. Powered directly from an a-c source, Thy-mo-trol is an adjustable-speed drive with exceptional control characteristics. It gives stepless speed control over a wide range, holds speeds constant under changing loads, and offers rapid, controlled current acceleration and dynamic braking. Speeds can be pre-set from a small dial that's part of the push-button control station.

A COMPLETE DRIVE

Standard Thy-mo-trol drives are available from 1/8 to 25 horsepower. And larger sizes can be furnished. Four compact units—d-c motor, electronic panel, power transformer, and control station—make up the complete drive. For full information, call your local G-E representative. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

676-191

THY-MO-TROL DRIVE

Keep on buying BONDS—*and keep all you buy*